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By L. H. BAILEY

II. The Cultivated Brassicas
III. Two Species of Hibiscus from China

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PART I

THE CULTIVATED BRASSICAS

For more than thirty years I have been especially interested in the botanical identity of the cultivated coles and mustards. In this period I have grown great numbers of them from seeds obtained in widely separated places, and have carried many of the biennials through to flowering and fruiting. Specimens have been taken freely in the wild, and in cultivation in different countries. I have given special attention to the Chinese and Japanese kinds, since they seem to be little understood botanically and are beginning to appear freely in North America.

These statements are intended only as an explanation of the reasons for this paper, describing a group of plants for the most part taken for granted and which seems not to be attractive to the systematist or to promise interesting conclusions. These plants are usually regarded by botanists as difficult of close determination, and the common knowledge of them is singularly confused.

This paper is in five parts:

1. The problem, page 53.
2. The genera; with a point of view on generic segregation, page 57.
3. The historic species; with comments on Linnæan types, page 63.
4. Description of the species, page 69.
5. Finding-list of the Latin names, page 107.

I. THE PROBLEM

My purpose in this contribution is to make a preliminary effort to identify and describe certain brassicas (including sinapis) currently cultivated, and to interpret them in terms of contemporaneous experience. I have naturally been carried into a review of some of the species growing without cultivation in North America; all these wild plants are introduced species. While the period of observation has been prolonged, the results do not seem to be commensurate with the effort, and the present paper can be considered nothing more than an introduction to the study of the group.

We are not prepared for much more than an introductory effort, because we seem not yet to have found the native center of these plants, at least of the mustard groups. The cultivated and weedy kinds are widely distributed about the world, but usually as introduced plants of indefinite origin. The evidence points to an Asian nativity. At all events, the Asian cultivated forms are legion, and they occupy a place in the food-economy of certain of the peoples (in the form of oil and herbage)

that is little realized in the West. Travelers will yet find the center of distribution. Dr. David Prain (now Sir David, Ex-Director of the Royal Botanic Gardens, Kew) in his bulletin on the mustards of India (1898) writes on the investigation of them: "Nor will this study be effective without simultaneous culture and study of the Chinese kinds among which, the writer is inclined to believe, will be found the stocks whence European and Indian forms alike have been derived." There has been no real study of the Chinese brassicas, so far as I know. I hope that the present paper will suggest the field that awaits exploration. Good and abundant specimens from native sources, taken systematically as other plants are collected, are much needed; the material should show complete foliage, mature fruits, also roots or notes and other records of root characters.

The cultivated brassicas are of two good groups,—the cabbage tribes and the mustard tribes. In English we have had no adequate popular general word for the plants known to the French as *chou*,—broadly "cabbage," not heading cabbages alone but the whole group of head-cabbages, cauliflower, kales, kohlrabi, rutabaga, and others. This group is the *kohl* of the Germans. In English, *cole* has been somewhat used in an indefinite way. I proposed it as a definite generic term for all these plants (the true Brassicas) in Principles of Vegetable-Gardening, 1901, pages 329–346, and it has become more or less current in North America. It is the counterpart of *mustard* (the true Sinapises).

These brassicas are the most baffling plants I have ever studied, although many of the difficulties vanish when the specific groups are properly separated. They are cosmopolitan; the characters of separation are relative and inexact; the plants are strangely polymorphous; the species established by the early founders are variously interpreted; seeds from one packet and under one name may yield different things; the material in herbaria is insufficient, and yet the quandaries may accumulate directly with the number of specimens. Authors disagree widely in the systematic treatment, and of course there can be no finality of opinion. Undoubtedly one source of confusion is the practice of including too many forms in one species, thereby weakening the definitions. The subject has been greatly obscured, for example, by placing rape, rutabaga, turnip, one or all of them, in *Brassica campestris*.

Another source of error is the natural effort to identify the Asian cultivated brassicas with species known in Europe. I think we must take a new approach to the oriental kinds. I am confirmed in this conviction by the remark of Prain that some of the difficulties of the subject "have arisen from the attempt to identify the various Indian mustards with European cultivated forms."

The subject is also obscured by the vast accumulation of synonymy

and citation. It is often difficult to determine just what plant a new arrangement of specific and varietal names may represent, and some of these names need be no longer carried in the literature. I am convinced, also, that the subject is not often clarified by separating the forms into groups subordinate to species and to variety. The binomials that have been bestowed in this group are very many and varied, indicating the variability of the plants and the indefiniteness of application of the early names.

In this paper, I am not dealing with origins or phylogenetic relationships. In these as in many other cultivated plants, the subject has been obscured by the effort to combine an hypothesis of the origins of the forms with the identification of them. If this method were followed with wild plants, systematic botany would be thrown into confusion. Finding wild plants sufficiently distinct and normal to demand separation in the interests of clarity, the botanist describes them; the question of their evolution is quite another problem. We may take the same approach to the study of cultivated plants, exercising care, of course, not to confuse botanical identity with horticultural distinctions.

When we have sufficiently identified the kinds, so that the work may have exactness, we may undertake to study the beginnings and the progress of these plants. Whether the group is in active process of mutation or whether it represents the break-up of old hybridizations, or whether we have many original species of close affinity, I do not pretend to know, and at this time I do not mean to postulate one or another. It is well known that some of the species can be hybridized, and I have made many crosses in the coles with curious results; but I have not been able to assure myself that the variations one ordinarily meets are the results of present spontaneous intercrossing. In a ubiquitous genus like Brassica, one does not expect to be without doubt on some of the specimens; but one cannot assume that variations are hybrids, particularly now that so many of the old notions about hybrids have been shattered. And of course the ability to hybridize cannot be held to invalidate specific lines.

Objection may be raised to the founding of species on plants obtained only as domestic subjects, although species of Linnæus, Thunberg, Loureiro, Roxburgh, and others, are still known only in cultivation, and our knowledge of the group is largely founded on plants either domesticated or escaped. But the botanical differences must be recognized, otherwise the group will remain in confusion. If it should finally be determined that some of the species of Brassica are racial variants, then the distinguishing and naming of them will have been justified in having stimulated the inquiry. Very likely the inquisitiveness of investigation has been restrained by the common practice of treating so many kinds of plants as

forms of one species, as if the matter were settled and beyond inquiry. Botanical nomenclature does not settle origins.

In the study of these plants I have come to be cautious about taking flowers, fruits and foliage indiscriminately from the progeny of one seed-packet even though the packet comes from a reliable source and under a designative name. I often find two or three recognized species in such progeny. I judge that some of the confusion in the genus has arisen from this mixing of seeds.

I have also had perplexing results with plants grown under glass. Some years ago I grew a good number of varieties of oriental derivation in a rather warm greenhouse, and I could not understand the herbarium material I made from them. On subsequently growing them in the open, the identity became clear. The divergence in leaf-characters was marked. In fact, this paper has been delayed a year to allow certain glasshouse puzzles to be studied in the outdoor garden.

As to the geography of the cultivated brassicas, we may recognize two groups or families: the occidental group, comprising the heading-cabbages with their kin and the turnips with their kin; the oriental group, comprising a variety of very different leaf-vegetables to which the name cabbage cannot be accurately applied, much grown in India, China and Japan. In parts of the oriental countries the brassicas afford a staple rather than an incidental article of food. It is not unlikely that they supply nitrogenous elements and vitamines, in foliage and seeds, that have played an important part in the persistence of the peoples. When one sees the yellow fields of mustards in the spring one is reminded more of fields of wheat than gardens of vegetables. There is seemingly considerable divergence between the kinds grown in India on the one hand and in China and Japan on the other. In India the emphasis apparently is primarily on the Campestris group, but this group seems to be of relatively small importance in the Far East. In India, however, the Juncea group is prominent, as also in China and Japan; and in China the Chinensis group is of great importance.

I have included here the cultivated brassicas of China and Japan (cf. Gent. Herb. 24) as well as those of Europe and North America. Although I have grown the Indian mustards, I have made no attempt to include them here, for they are treated in detail in Prain's paper (to which I have already referred) on "The Mustards Cultivated in Bengal," published as Bulletin No. 4, Agricultural Series No. 3 of the Department of Land Records and Agriculture, Calcutta, 1898, the nomenclature of which I have more or less traced herein. Prain's paper has special interest in the fact that the careful portraits are made in part from the old unpublished drawings of Roxburgh.

The sources of the original botanical descriptions of the species and

varieties of Brassica and Sinapis considered in this paper are mainly these: Linnæus, Species Plantarum, 1753, and subsequent publications; Thunberg, Flora Japonica, 1784; Loureiro, Flora Cochinchinensis, 1790; Roxburgh, Flora Indica, 1832; DeCandolle, Regni Vegetabilis Systema Naturale, ii, 1821; also Trans. Hort. Soc. London, v, 1–43, 1824, and Prodromus i, 1824. To these should be added such outstanding works from the horticultural-botanical side as Metzger, Systematische Beschreibung der Kultivirten Kohlarten, Heidelberg, 1833; Brassica and Sinapis in Alefeld, Landwirthschaftliche Flora, 1866; Prain, The Mustards Cultivated in Bengal, already cited. The latest botanical treatment, and the completest monograph yet attempted, is by O. E. Schulz in Engler, Pflanzenreich, heft 70, 1919 (iv, 105). Other contributions are cited as we proceed.

II. THE GENERA; WITH A GENERAL POINT OF VIEW ON GENERIC SEGREGATION

Before approaching the problem of identification we must decide the generic lines. The coles and mustards are of the two old genera Brassica and Sinapis. These genera go back to Linnæus, Genera Plantarum, 1737, and without description (*nomina nuda*) to the Systema Naturæ, 1735; also to Tournefort Institutiones Rei Herbariæ i, 219, 227, tt. 106, 112 (1700). Brassica has priority of place in Linnæus Genera Plantarum, where botanical characterization is first given (but not in the bare list in the first Systema), so that if the two genera are combined Sinapis must be subordinated; Linnæus considers Brassica the major by comparing Sinapis with it.

The generic distinctions drawn by Linnæus in the Genera are summed up for Sinapis in "Hinc a Brassica differt calyce patente, et stylo longitudine germinis." In the second edition of the Genera, 1742, 1743, the summary characters separating Sinapis are: "Hinc Sinapis calyce patente, unguibus vero Corollæ erectis a Brassica differt." This characterization of the second edition is retained in the third edition, 1752; and then comes Species Plantarum, 1753, in which the two genera are distinguished by the list of species in each. Sinapis then has five species, *SS. arvensis, alba, nigra, juncea, hispanica*; these species are retained in the second edition (1763), and others are added. It will be noted that the separation of the genera rests on characters of the calyx, style, and claws of the petals. These characters were retained in the Genera Plantarum throughout Linnæus' life. In the ninth edition, by Sprengel, 1830, the outstanding characters of separation were reduced to two,—calyx *erectus* for Brassica and *patentissimus* for Sinapis.

In DeCandolle's Systema (Regni Vegetabilis Systema Naturale, ii, 582, 607. 1821), Brassica and Sinapis are more fully defined, although the

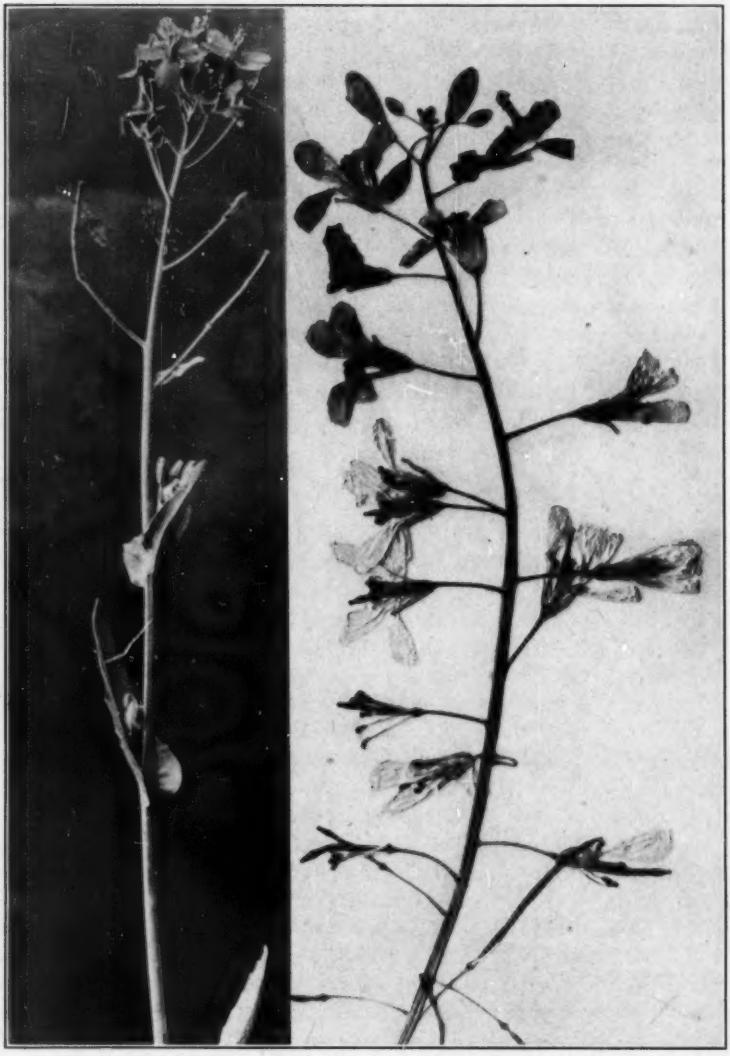

FIG. 18. CONTRAST IN INFLORESCENCE—*Brassica oleracea* var. *capitata* (CABBAGE) RIGHT; *Brassica Rapa* (TURNIP) LEFT.

essential characters of separation are reduced to the closed calyx and obtuse style for the former, spreading calyx and acute style (with nerved valves) for the latter. In the Prodromus i, 213, 217 (1824) these distinguishing characters are retained. These marks of separation hold through the compilers of the middle of last century; there are slight variations, as when Endlicher, Genera Plantarum, 882 (1836–1840), makes the calyx of Brassica *clausus v. patens*. The calyx characters break down as a greater range of forms is brought under review. Thus Trautvetter is obliged (Bull. Soc. Nat. Moscow, xxxiii, 134. 1860) to describe *Brassica Besseriana*, a new name for *Sinapis juncea*, L., as having calyx "erecto-patentibus."

The fruit characters were taken up by Wilhelm Daniel Joseph Koch, apparently the first to transfer *Sinapis nigra* to Brassica thereby making a closer definition of Sinapis. He separates the genera, in his Synopsis Florae Germanicæ et Helveticæ, 1837, on characters of the silique: "Brassica,—Siliqua . . . nervo dorsali recto, lateralibus nullis, vel notatæ venis, in nervum lateralem obscurum utrinque anastomosantibus. Sinapis,—Siliqua. . . .nervis tribus vel quinque rectis validus."

Under the influence of the English botanists (Hooker, *et al.*) and the general movement toward consolidation of genera, Sinapis was merged into Brassica, and it has so remained in some of the great compilations: Bentham & Hooker, Genera Plantarum, i, 84 (1862); Baillon, Histoire des Plantes, iii, 188–195, 248 (1872); Durand, Index Generum Phanerogamarum, 16 (1888); Index Kewensis, 334, 913 (1893, 1895). Krause covers the whole of them in his all-inclusive genus Crucifera (E. H. L. Krause, in Sturm's Flora von Deutschland, ed. 2, vi, 1902). In many floras the single-genus disposition is followed.

Latterly, however, in the reverse movement toward segregation, Sinapis has been again accorded an independent status: Prantl, Die Natürlichen Pflanzenfamilien, iii, 2, pp. 176, 177 (1891); Dalla Torre & Harms, Genera Siphonogamarum, 185, 186 (190 1; Hayek, Cruciferensystems in Beihefte zum Botanischen Centrallbatt, xxvii, 258 (1911), with reservations; Schulz, in Engler, Pflanzenreich, iv, 105, pp. 21, 117 (1919). In many floras the two-genera disposition is followed.

With the revival of the genus Sinapis have come other definitions of it, founded mostly on the mature fruit, largely following Koch. The characters lie essentially in the short conical beak and one-nerved valves of Brassica, and the flat, angled or elongate beak and three, or more, nerved valves of Sinapis.

It is indication of the difficulty of finding clear definition that authors differ so widely as to which of the species shall be named in Brassica and which in Sinapis. Thus, while *nigra* is placed in Sinapis by Linnæus and by DeCandolle, it is named in Brassica, for example, by Migout, Flore du

Department de l'Allier, 21 (1866); Loret & Barrandon, Flore de Montpellier, 30 (1888); Prantl, l.c. 177; Ascherson & Graebner, Flora des Nordostdeutschen Flachlandes, 360 (1898); Britton & Brown, Illustrated Flora of the Northern United States, etc., ii, 193 (1913); Schulz, l.c. 75. It is placed in Sinapis by other recent authors who prefer to keep the two genera distinct: Bubani, Flora Pyrenaea, 192 (1901); Coste, Flore de la France, 75 (1901); Groves, Babington Manual of British Botany, 9th ed. 32 (1904). Similar results might be uncovered if *Sinapis juncea* and others were traced.

As the mustards are frequently referred to Brassica by those who retain the two genera, so have some of the coles and turnips been referred to Sinapis by authors keeping both genera: *Sinapis Napus* and *S. Rapa*, Brotero, Flora Lusitanica, i, 586 (1804); *S. Rapa* var. *silvestris* (campestris), Stokes, Botanical Materia Medica, iii, 479 (1812).

These few citations at random show the lack of any commonality in the understanding of the two genera and indicate the artificiality of the separation. If all the species in the two classes were taken into consideration, these difficulties would be increased.

If we were to assume the first species listed by Linnæus under a genus as the type of that genus, then the name Brassica must supplant Conringia (which is a *nomen nudum* apparently up to the time of Link, 1822), inasmuch as the initial species, *Brassica orientalis* Sp. Pl. 666, is Conringia. In such event, one of the several old generic names would have to be brought forward for Brassica if the genus is kept separate from Sinapis; or in case the two genera go together, the group would become Sinapis. In either case, a new series of nomenclatorial combinations would need to be made. We may be saved such misfortunes, however, by Linnæus' reference, in Genera Plantarum, to Tournefort and also in the clear enumeration in Hortus Cliffortianus, by which *Brassica oleracea* may be assumed as the type of the genus.

The Tournefortian conception of Brassica is to include the coles (choux), and of Sinapis to include the mustards. This undoubtedly was also the Linnæan conception. In fact, the fourth edition of the Systema published in Paris in 1744, and ascribed to B. Jussieu, "accesserunt nomina Gallica," has Brassica. T [ourn.] (including Rapa. T. and Napus. T.) of which the French name is *le Chou*; it has Sinapis (Sinapi. T.) of which the French is *la Moutarde*.

Now, to the non-botanist, the coles and mustards are separate groups. They are distinguished by the thick glaucous foliage of the coles with an elongated inflorescence in anthesis, larger and longer-clawed petals which are often ochroleucous or very light yellow, mostly erect calyx with the sepals more or less saccate at base, large long mostly conical-beaked pods, and non-piquant seeds; and by the soft green foliage of the mustards with

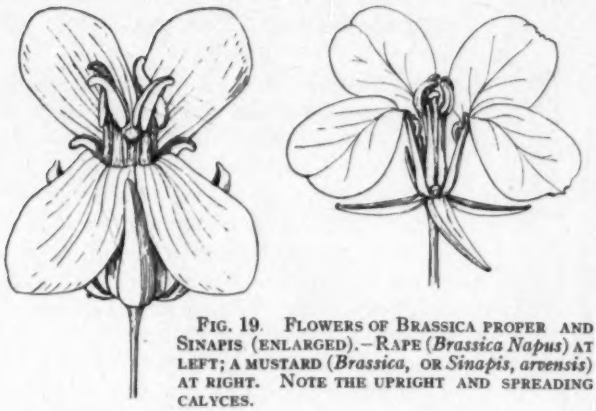

FIG. 19. FLOWERS OF BRASSICA PROPER AND SINAPIS (ENLARGED).—RAPE (*Brassica Napus*) AT LEFT; A MUSTARD (*Brassica*, OR *Sinapis, arvensis*) AT RIGHT. NOTE THE UPRIGHT AND SPREADING CALYCES.

a short inflorescence in anthesis, smaller flowers and shorter-clawed petals which are mustard-yellow, mostly spreading not saccate calyx, smaller and shorter pods often with very prominent and flattened beaks, and piquant seeds. There has been little attempt to put all these differences into botanical form, for they are indefinite, open to many exceptions, and incapable of measurement and descriptive statement; one set of characters may not go with another set. Sometimes some of the less definite features may be stated in the generic contrasts, as in Coste, Flore de la France, 71 (1901): "Sinapis,—sépales très étalés; graines à saveur piquante; plantes vertes ou grisâtres; Brassica,—sépales dressés ou peu étalés; graines à saveur douce; plantes plus ou moins glaques."

The general characters of separation, the "looks" of the plants, are striking at the extremes, but the species that lie between and are as much the one as the other are not to be overlooked in the definitions. At the beginning of the series are the true coleworts, the Oleracea tribes, with heavy glaucous foliage, elongated inflorescence open in anthesis (Fig. 18), ochroleucous or very soft yellow flowers with long-clawed upstanding petals, erect sepals often somewhat saccate at base, long siliques and a tapering conical silique, the valves without marked features in the way of nerving or vestiture. The short inflorescence in anthesis of the mustards and even of the turnip (Fig. 18) in which the open flowers equal or exceed the unexpanded buds, is a marked feature farther down the series; yet this feature is so inconstant in some of the mustards as to be of little value in definition. Figs. 18, 19, 20 exhibit some of the characteristic contrasts.

I am impressed with the fact that coles are coles and mustards are mustards; and if we separate Sinapis from Brassica we must let *S. nigra*

FIG. 20. FRUITS OF BRASSICAS PROPER AND SINAPIS (A, NATURAL SIZE; OTHERS X 1½).—A, WILD *Brassica oleracea*; B, *Brassica narinosa*; C, *Brassica alba*; D, *Brassica arvensis*; E, *Brassica nigra*.

go with it for it is a true mustard, source of most of the table mustard of commerce.

But because the coles and mustards are well-known groups, it does not follow that, in botanical nomenclature, the two should be placed in separate genera, unless indeed there are clear and fairly constant definitive characters of contrast, any more than that cauliflowers and turnips, because they are markedly separate groups, should be in different genera for that reason. Genera should show agreements rather than differences: the species show the differences. It is more important to know that the coles and mustards are generically related than to know that it is possible imperfectly to separate them.

We may say that "this is an apple" and "this is a pear," but this is no reason for placing them in separate genera: it is rather the more reason for keeping them together (unless there are clear and marked technical characters of separation) in order that relationships may be recognized. We are not justified in separating raspberries and blackberries because they are popularly recognized groups; nor cucumbers and melons, pyrethrums and chrysanthemums, Cerasus and Prunus, Primocarex and Vignea. By too great segregation we practically lose the value of genera, and then their chief significance is only the convenience they contribute to nomenclature.

There appears to be general agreement that the genera of Bentham & Hooker are too broadly conceived. That great work reflected the synthesis of Darwin's time. We are now in an epoch of ultra-analysis. One may not say that the aggregation of the former time or the segregation of the present time is right or wrong; but probably the best practice of the future (so long as we hold the concept of genus with species) will find itself somewhere between the two.

For these reasons and also because I am unable to tell whether some of the plants treated in this paper are coles or mustards, I have kept Brassica and Sinapis together. If separation must be assumed, then it may be best to go still farther and divide the group into three or more genera, for which we have precedents in Bonannia, Presl, Fl. Sic. i, 99 (1826); Napus, Schimp. & Spenn., Fl. Friburg. iii, 939 (1829); Melanosinapis,

Schimp. & Spenn. l. c. 944; Sinapistrum, Chev. Fl. Par. ii, 869 (1836); Leucosinapis, Spach, Hist. Nat. Veg. vi, 348 (1838); Agrosinapis, Fourr., Ann. Soc. Linn. Lyon, n. s. xvi, 329 (1868); and others. If two and only two genera are to be retained, we are practically forced to define one of them very closely, including but few species, and to constitute the other very broadly. The present tendency with those who prefer two genera is to expand Brassica and strictly to limit the definition of Sinapis.

Large genera have marked advantages over little ones. if they are sufficiently homogeneous to admit of fairly clear definition. The broad concept brings many similar objects into one fascicle for comparison. It is a great gain to understanding of relationships to know that peaches, plums and apricots may be clearly brought into one group with a common name. So is it an advantage in such genera as Eupatorium, Pyrus, Crataegus, Rubus, Aster, Senecio, Hieracium, Solanum, Epidendrum, Carex, Scirpus, Panicum. The large genus has distinct merit in generalized groups. The segregation of such groups may weaken rather than strengthen the feeling for affinities, and it also multiplies and complicates the literature for all future students. The large genus also economizes space in a book, by the elimination of superfluous generic descriptions; and it consolidates the mental processes. Because we now segregate species with great freedom, it does not follow that we may apply the same practice to genera. The underlying principle, I think, is this: genera for synthesis and relationships; species for analysis and distinctions.

III. THE HISTORIC SPECIES; WITH COMMENTS ON LINNÆAN TYPES

The first problem in identification is to establish the historic types of the old species. These species, so far as they come specially within the range of this paper, are:

Brassica campestris, L. Sp. Pl. 666 (1753).
B. Napus, L. l.c.
B. Rapa, L. l.c.
B. oleracea, L. l.c. 667.
B. chinensis [Juslenius] in Linn. Cent. Pl. i. (1755); in Linn. Amoen. Acad. iv, 280 (1759).
Sinapis alba, L. Sp. Pl. 668.
S. nigra, L. l.c.
S. juncea, L. l.c.
S. chinensis, L. Mant. i, 95 (1767).
S. brassicata, L. Syst. ed. xii, iii, Append. 231 (1768)
S. cernua, Thunb. Fl. Jap. 261 (1784).
S. japonica, Thunb. l.c. 262.
S. pekinensis, Lour. Fl. Cochin. 400 (1790).
S. dichotoma, Roxb. ex. Flem. in As. Res. xi, 179 (1810); Fl. Ind. iii, 117(1832)
S. glauca, Roxb. F. Ind. iii, 118 (1832).
S. ramosa, Roxb. ex. Flem. l.c.; Fl. Ind. l.c. 119,
S. trilocularis, Roxb. Fl. Ind. l.c. 121.
S. cuneifolia, Roxb. l.c.
S. rugosa, Roxb. l.c. 122.
S. erysimoides, Roxb. l.c 123.

S. patens Roxb. l.c. 124.
S. pusilla, Roxb. l.c. 125.

To other early Linnæan plants I have given no attention for they are referred by monographers to other genera: *Brassica orientalis* to *Conringia orientalis; B. Erucastrum* to *Brassicella Erucastrum; B. Eruca* to *Eruca sativa; B. vesicaria* to *Eruca vesicaria; Sinapis hispanica* to *Erucaria myagroides; S. laevigata* to *Erucastrum lævigatum; S. incana* to *Hirschfieldia incana* (*Brassica adpressa*, Boiss.), introduced in California.

The Roxburghian species I have not cited from Hortus Bengalensis, 1814, as they are *nomina nuda* there. Fortunately they are well described in Flora Indica (1832), and certain of them have an earlier origin. *Sinapis dichtoma*, Roxb. is made by Prain *Brassica Napus* var. *dichotoma*; by Duthie and Fuller, Field and Garden Crops of the N. W. Prov. and Oudh (1883), *B. campestris* subsp. *Napus* var. *dichotoma*. *Sinapis glauca* and *S. trilocularis*, Roxb. are made *B. campestris* var. *Sarson*, Prain and varieties of *B. campestris* subsp. *Napus* by Duthie and Fuller. Of *Sinapis pusilla* and *S. divaricata*, Roxb. there are no drawings; these have been referred by British botanists to *Nasturtium montanum*, Wall. (=*Roripa montana*, Small) and *Nasturtium indicum*, DC. (=*Roripa indica*, Bailey). Roxburgh does not include *Sinapis juncea*.

I have photographs of specimens in the Linnæan herbarium, London, although only one of the species specially studied here, *Sinapis juncea*, is represented in that herbarium by a true type specimen (excepting *B. alba*, which is not in dispute); of the *Brassica Napus* of Hortus Cliffortianus, preserved in the Natural History Museum at South Kensington; also of Thunberg's types in Upsala; and of Roxburgh's original unpublished drawings of his species, now at Kew, there being no type specimens. The faithful photographs are indispensable to a study of these puzzling plants when one cannot have daily access to the plants themselves, and I am under obligations to the persons and institutions who have so readily supplied them.

The Linnæan species of Brassica of special historic difficulty are *B. campestris*, *B. Rapa* and *B. Napus*, together with *B. chinensis* and *Sinapis brassicata* in the East Asian field.

We are to understand at the outset that Linnæus did not "found" species in the modern sense. In his Species Plantarum he brought order out of confusion by making an inventory of plants known in preceding writers and by placing a marginal name opposite the citations as a brief substitute for the old cumbersome phrases. Many of the categories now known as "species" are established only on old citations, with frequently the added advantage of reference to illustrations. It does not follow that all the citations under a given marginal or "specific" name belong to what we would now regard as a single species. Often, therefore, it is a question of interpretation as to how his name shall now apply. In many cases it is

impossible to satisfy oneself with any interpretation. If the case is hopeless, the Linnæan name may be dropped; but if there is a fairly clear application to two or more interpretations, we are then bound to give weight to the usage of those immediately following Linnæus and not arbitrarily impose an interpretation made more than one hundred and fifty years later.

In many cases, Linnæus made his description *de novo* from a dried specimen; this specimen we now take as the "type" of the species. In other cases, he added a specimen to his herbarium after the species, founded on old citations, was published, and wrote his published nomial on the sheet; in this case, the specimen is not a type yet it is valuable in showing his conception of the species, but if there is clear disparity between the specimen and the published citations or descriptions, the citations are to take precedence; there are cases of this kind in Brassica.

On the use of the Linnean herbarium (now in the custody of the Linnean Society of London), the following note by Dr. Benjamin Daydon Jackson, General Secretary of the Society (Proc. 1906–7, p. 93) is of service: "It must not be allowed to escape our minds that the Linnean Herbarium differs in many respects from the modern idea of an herbarium. Carl von Linné in a multitude of cases described his species from the books of his predecessors, and his dried plants were frequently used to modify the diagnoses of the previously described species. It was only when he was strictly confined to a single specimen that Linné was forced to keep the plant actually under his eyes, and to describe it as would now be done with newly found plants."

We may now return to the confusing cases of *B. campestris*, *B. Rapa*, *B. Napus*. We are first to note that certain plants had long been known in the literature as Brassica, others as Rapa or Rapum, others as Napus. Rapa and Napus are ancient names for turnips, the former usually applied to what we now know as turnip, and the latter to what is now called Swedish turnip or rutabaga and also to rape or colza. The English word *rape* is from the Latin *rapum*, a turnip (feminine *rapa*). There are many old descriptions and illustrations of these various kinds of plants. Linnæus recognized these classes, bringing most of the Brassicas together under *Brassica oleracea* (cabbage class) and *B. campestris*; the kinds of Rapa under *Brassica Rapa*; and the kinds of Napus under *Brassica Napus*. All the indefiniteness of the early descriptions and identifications was brought together under the new binominals.

If, to the inherent inexactness of the compiled citations we add the personal interpretations of different subsequent authors, and the confusion necessarily resulting from the attempt to postulate origins by means of the nomenclature, we are not surprised to find much of the literature unusable. Moreover, we cannot be certain in all cases that the plants we

FIG. 21. THE *Brassica campestris* OF CLUSIUS AND *B. sylvestris perfoliata* OF DODOENS, CITED BY LINNÆUS.

now cultivate are identifiable with the forms of two hundred and more years ago, nor are we thereby under obligation to continue to this day all the old Latin names of domesticated kinds.

Eliminating from taxonomy the effort to state the supposed origin of one class from another, we make the first contribution to clarity. Thus *Brassica campestris* becomes clear. It is an annual weed, mostly branching from the base, common in Europe and North America, with cordate-clasping leaves, having nothing immediately to do, so far as I can see, with the turnip or the rutabaga, although I have heretofore formally followed the De-Candollean reference of the rutabaga to it. The citations of Linnæus, in Species Plantarum, and in Hortus Cliffortianus (on which the Species Plantarum is so largely founded), are to plants designated as "campestris" and "sylvestris:" they are wild or spontaneous plants of the fields. The stem and root both are slender ("tenui"). The cited pictures are clear. The one here reproduced from "Clus. hist. 2. p.127" identifies the plant at once notwithstanding that the height is unnaturally shortened to make it adaptable to the page and the pods are more or less formalized. Fig. 21. Moreover, there is a specimen of *B. campestris* in the Linnean herbarium named in Linnæus' hand. A photograph of it

is before me. Although the specimen is subsequent to the publication of the species, it is clearly the same plant that the cited pictures represent.

The case of *Brassica Rapa* (turnip) is not difficult, unless we try to combine it with some other species or class. It has good mark of its own. The citations are to cultivated forms, and we are told in Hort. Cliff. that it is scattered in fields in Belgium, England, etc., "e deciduis seminibus et rejectis enata,"—from falling seeds and cast-out material. It is not said to be "sylvestris." But not knowing where it is natively wild is no reason for uniting it with *B. campestris* or other classes. The root is "carnosa," thus differing from *B. campestris* and even from *B. Napus*. He marks *B. Rapa* as biennial, whereas *B. campestris* is marked annual. The *Rapum vulgare* of "Dod Pempt. 673," cited in Hort. Cliff., is clearly a turnip. Fig. 22. Linnæus left no specimen of *B. Rapa*.

FIG. 22. THE *Rapum vulgare* OF DODOENS, ONE OF THE CITATIONS BY LINNÆUS FOR *Brassica Rapa*.

It is not so clear with *Brassica Napus* (rape). The citations are confusing. *Napus sylvestris* is one of the citations. So is the "Napus" of Dodoens, which shows a big-tuber turnip with the root character of rutabaga; and Schulz, in his recent monograph, cites it under *B. Napus* var. *Napobrassica*, the rutabaga class. But we cannot refer the rutabaga to *B. Napus* on the authority of Linnæus for he places it with the cabbage,

B. oleracea var. *Napobrassica*; nor can I refer it to *B. Napus* for it has botanical marks of its own, and I have no evidence that these marks vanish. From the citations in Linnæus, one cannot be certain to what other plant to apply the name *B. Napus*; but it has been a prevailing practice from the early post-Linnæan botanists to hold the species for rape or colza; if it cannot be held for that class, then I do not know what binomial the rape may take. Moreover, there is a specimen, named *B. Napus* in Linnæus' hand, in his herbarium, and a photograph of it is before me. This specimen was added subsequently to the publication of *B. Napus* in Species Plantarum, but as it agrees with the plant I know as rape, I consider it confirmatory evidence. At all events the case becomes clearer by leaving *Napobrassica* (rutabaga) out of it. Perhaps we have been misled by the description of the root of *B. Napus* in Species Plantarum, as "fusiformi." This undoubtedly is used in contrast with the root "tenui" of *B. campestris* and "orbiculari depressa carnosa" of *B. Rapa*: it does not mean a very slender root on the one hand nor a fleshy root on the other, but a somewhat thickened hard spindle-shaped root, such as one sees in the rape. In Hort. Cliff. (No.3) is a long original description of the plant which Linnæus understood as *B. Napus*. Nothing is said about the root, which he could not have disregarded had he intended to designate any kind of turnip or rutabaga. The plant, he records, grows among crops and along ditches in England and Belgium; and between Amsterdam and Harlem it grew along the roads and blooms in April: this does not suggest rutabaga. There is a specimen in the Cliffordian Herbarium (now at the British Museum) ticketed No. 3, and a photograph of it is before me; although the flowers are rather large, it represents the rape series.

Although I cannot make an adequately clear species-concept for *B. Napus*, yet I must recognize such a plant; to disregard it or to refer it elsewhere would increase rather than enlighten the difficulties. The historic continuity of it must be considered.

To cover the difficulties attending these three Linnæan species, Syme proposed (Engl. Bot. ed. 3) *Brassica polymorpha*, diagnosing thereunder *B. Napus*, *B. campestris*, *B. Rapa*. This method of establishing an aggregate name or a "holding company" (to borrow a current commercial term) to include several perplexing species is no longer admissable: it does not eliminate the necessity of understanding the objects nor does it make the differentiation any simpler; it is likely to lead directly to confusion.

Similarly, it does not conduce to clarity to establish a holding-name or super-species for a miscellaneous company of domesticated forms, as was recently proposed by Léveillé; but as his proposal is so unusual in two or three respects and the suggestion is so little known, we may consider it further.

The disposition of the case by Léveillé.

The treatment of the cabbage-brassicas by Mgr. H. Léveillé in 1910 is an article called "Essai d'une clef des Brassica oleracea et Rapa." (Le Monde des Plantes, ser. 2, xii 24, 25, May 1910; with supplementary note on p. 32, Aug. 1910). He arranges the cabbage-brassicas (*les choux*) in two species, *Brassica oleracea*, L., and *B. Rapa*, L. The "variétés du B. oleracea" are four: *B. insularis*, Moris, *B. Pourrettii*, Fouc.& Rouy, *B. Robertiana*, Gay, *B. Suttoniana*, Lév. The last, *B. Suttoniana*, includes all the "formes cultivées." This "variety" is named in compliment to Arthur W. Sutton whose excellent paper on brassica crosses (Journ. Linn. Soc. Bot. 38, 337-349, and separately published) was reviewed by Léveillé in Le Monde des Fleurs, which is a supplement to Le Monde des Plantes, January 1910; it is this contribution of Sutton's that suggested the Essai.

The cultural forms included under *B. Suttoniana* as "sous-variétés" are named as if they were real binomials, and they are so cited by Index Kewensis, Suppl. iv, although Fedde, in reporting them, treats them as subordinates. Léveillé clearly means them as sub-varieties although he gives them a binomial form, a practice with considerable old usage to support it. The sub-varieties listed are *B. acephala*, DC., *B. quercifolia*, DC., *B. gemmifera*, Lév., *B. millecapitata*, Lév., *B. bullata* DC., *B. capitata*, DC., *B. caulorapa*, DC., *B. Botrytis*, DC. Léveillé probably makes the citations of authorities only as indicating the origin of a nomial and not as authority for the combinations, although he is either not consistent or not accurate in this respect; thus "*B. bullata*, DC." is properly, in DeCandolle, *B. oleracea* var. *bullata*, DC.

The "races du B. Rapa" are *B. Napus*, L. and *B. campestris*, L. The "variétés du B. Napus" are cited as *B. Napus*, L. and *B. pseudo-Colza*, Lév. The "variétés du B. campestris" are *B. Colza*, Lév., *B. Napobrassica*, DC., *B. Rutabaga*, Lév.

The new combinations or sub-binomials in this publication by Léveillé are *B. Suttoniana*, *B. millecapitata*, *B. pseudo-Colza*, *B. Colza*. I do not know what some of the binomials signify.

Aside from the new binomials, the outstanding departures of Léveillé's treatment are the founding of the composite *B. Suttoniana* for "l'ensemble des formes de Brassica cultivés," and the making of *B. campestris* a race of *B. Rapa* although the latter disposition was long ago made by Koch.

Earlier species by Léveillé I know only from descriptions and have not been able to place them satisfactorily. I did not find specimens of them in the Léveillé herbarium now at the Royal Botanic Garden, Edinburgh. I refer to *Brassica antiquorum* and *B. Argyri*, in Fedde Repert. Nov. Spec. iv, 227 (1907); *B. Taqueti* and *B. oleracea* var. *hongoensis* in Fedde l. c. ix, 349, 350 (1912).

IV. DESCRIPTION OF THE SPECIES

The descriptions herewith are of those cultivated forms I have particularly studied, together with briefer references to a few others. I make no attempt in this paper to trace the histories in books, as I am concerned at present only with identification. The evolution of the forms, as I have already indicated, is quite another quest. I follow the general assumption that the kales, heading cabbages and cauliflowers are derivatives of *Brassica oleracea* of the cliffs and shores of Europe. I know of no other source to which to ascribe them. Several times I have taken this plant in the wild and have grown it (Fig. 23), but I have not observed variations suggesting the highly modified domesticated forms; yet these forms are apparently fairly within the range of possibilities of the wild species. I cannot think, however, that the turnip tribes are derived from this species, as certain authors suppose. This, I take it, is also the conclusion of Sutton in his suggestive paper on "Brassica Crosses" to which I have referred above.

What may be the genetic relationships between rape, rutabaga (swede)

and turnip (*B. Napus*, *B. Napobrassica* and *B. Rapa*) it is futile to conjecture from the evidence at my command. Breeding experiments of a kind quite different from the prevailing type of studies may lead to direct conclusions. Persons contemplating breeding experiments must, of course, familiarize themselves with the extensive studies of Dr. Birger Kajanus, reported in Zeitschr. für Pflanzenzüchtung beginning 1912. Sutton concludes that "the turnip and swede-turnip are no doubt specifically distinct." This is my inference from botanical considerations. It is not too much to suppose that two or more weedy species of true Brassicas are really native in Eurasia, as several species of Chenopodium are native

FIG. 23. WILD CABBAGE, *Brassica oleracea*, GROWN AT ITHACA, N. Y., FROM SEEDS OF WILD PLANTS TAKEN ON THE ENGLISH CHANNEL; THE PLANTS ARE SHOWN IN THEIR SECOND SEASON.

and have followed man as weeds in his migrations, and that the rapes, rutabagas and turnips may have had independent origins. The attempt to cover these species in *B. campestris* has confused the situation. I am not at all sure that the *B. campestris* so widespread as an introduced plant in North America is all one species. Very likely there are more specific roots in the cultivated Brassicas than we have been willing to admit. This is specially likely in the Brassicas of China and Japan, which

have been much confused with the species of India and of Europe. I have found little adequate material of these oriental plants in the herbaria.

For the most part, the cultivated Brassicas are more clearly treated as separate species or categories than as varieties of wild or weedy species. It is easy to assume, but difficult to prove, that the weedy kinds are the run-wild forms of cultivated kinds.

From the horticultural point of view, my interest in the Brassicas is particularly in the succulent edible product rather than in the yield of seed for the manufacture of table mustard or oil. The large radical leaves, that are chiefly sought in the vegetable-garden but which are seldom well represented in herbarium material, show good botanical characters. The leaves may be readily confused, in many cases, with those of some kinds of oriental Raphanus. Several of the species yield oil from the seeds, as do some kinds of radish. I have not made *oleifera* varieties, however, nor have I carried the old varieties of this kind in my citations, for the reason that they do not represent descriptive botanical differences any more than do the variously pungent kinds of capsicum or the flavor-varieties of turnips and apples.

The descriptive work in the following pages is necessarily drawn from my own herbarium, in which are some 1,500 sheets of Brassica. It is to be expected, however, that some of the specimens in such a range do not readily yield to satisfactory identification. The case would be simpler if the specimens were fewer. As indicated at the beginning of this paper, a large part of the specimens are from my own growing; most of the cultivation has been at Ithaca, N. Y., but some of the material I grew and assembled in China.

It is needless to say that this study is made solely from the point of view of the systematic botanist. The pharmaceutical and physiological questions are of a wholly different character and are mostly concerned with other problems than the determination of species. How far the chemical contents of mustard seed follow recognized specific lines is unknown to me; much must depend on purity of stock and perhaps also on the soil and other conditions under which plants are grown. I have observed odd manifestations in sexual sterility, but have not investigated this special subject; the reader is referred to the extensive studies by A. B. Stout. (cf. Bot. Gaz. lxxiii, 110-132).

I am under obligation to many persons and institutions who have aided me in this Brassica quest. I have had free use of the collections and libraries of the New York Botanical Garden, and of the Gray Herbarium of Harvard University, whose officers have also aided me; and I have had privileges in various collections abroad. I am also under special obligation to the R. T. French Company, Mustard Street, Rochester,

New York, manufacturers of mustards, and personally to the officers, for information, specimens, and for many seeds for planting.

KEY TO THE SPECIES HEREIN DESCRIBED

A. Plant glaucous-blue or blue-green (varying to red in hort. vars.): foliage usually thick, sometimes succulent, the mature leaves glabrous: flowers large, 10–25 mm. long, white, cream-yellow, very light yellow, or ochroleucous, the petals long-tapering into narrow bases, sepals mostly firmly erect and not spreading. —The coles; herbage drying slowly in the plant-press.

B. Flowers large, 15–25 mm. long, white or very light colored, the inflorescence elongated and open at anthesis, 10–25 cm. long: young radical leaves glabrous.

C. Color of flowers ochroleucous or creamy, often light: plant biennial to perennial.

D. Leaves large, mostly thick, some or all of those on flowering stem sessile or variously clasping: stem not tuberous ..... 1. *B. oleracea.*

DD. Leaves relatively small, thinner, those on flowering stem slender-petioled: stem tuber-thickened..... 2. *B. caulorapa*

CC. Color of flowers clear white: annual..... 3. *B. alboglabra*, n.sp.

BB. Flowers smaller, 15 mm. or less long, light yellow, the inflorescence at anthesis short with flowers clustered at top, the blooming part usually 6 cm. or less long: young radical leaves sparsely setose-hairy.

C. Prevailing stem-leaves oblong-lanceolate, toothed and notched: pedicels slender, strongly ascending: fruit long and slender, the narrow beak mostly above 1 cm. long: root not tuberous or prominently thickened, mostly in the form of a straight tap-root..... 4. *B. Napus*

CC. Prevailing stem-leaves with large terminal lobe and one or two pairs of smaller lobes at base: pedicels stout, strongly divaricate, the stout beak usually less than 1 cm. long: root a large tuber..... 5. *B. Napobrassica*

CCC. Prevailing stem-leaves oval with very long petioles bearing a few leaf-fragments, and the upper ones narrow and clasping: pedicels slender, ascending, the thin beak 8 mm. or less long: root a small comely tuber ..... 6. *B. napiformis*

AA. Plant green or essentially so, only thinly or not at all glaucous (sometimes rather prominently glaucous in no. 7): leaves mostly thin, often sparsely setose-hairy on the ribs and veins: flowers small, 10–12 mm. or less long, bright yellow or sulfur-yellow, the petals less prominently tapering, sepals separating or spreading.—The turnips and mustards; herbage drying rapidly in press.

B. Beak of mature silique slender or conical, terete in section, not seed-bearing.

C. Cluster of radical leaves not greatly developed: stem-leaves cordate-clasping: annual, root not enlarged and usually shallow and branching and not forming a straight developed tap-root..... 7. *B. campestris*

CC. Cluster of radical leaves large and usually much delevoped (in the cult. plant), often affording an article of food: plant essentially green: stem-leaves various: annual, biennal or perennial.

D. Mature silique spreading, standing away from the axis of the raceme.

E. Root a large tuber (turnip): stem stout and strict, usually not branching near base: biennial..... 8. *B. Rapa*

EE. Root not tuberous or turnip-like, but the stock sometimes thick and woody: stems stout or slender, often branching low.

F. Main leaves extended, long and narrow, very slender-petioled, entire or laciniate: annual and biennial..... 9. *B. nipposinica*, n.sp.

FF. Main leaves broad, stout-petioled.

G. Leaves lobed, the margins notched or angle-toothed, those on the stem not clasping: all of them sometimes crisped or laciniate: annual..... 10. *B. juncea*

GG. Leaves not lobed, the margins evenly dentate-serrate or doubly serrate, on stem not clasping: annual ..... 11. *B. integrifolia*

GGG. Leaves mostly not lobed, except sometimes lyrate along the petiole, and the margins not regularly notched or dentate, usually nearly or quite entire: petiole mostly broadened: stem-leaves various: biennial or annual.

HH. Radical and lower stem-leaves tapering to broad flat whitened tooth-winged petiole: stem-leaves clasping: annual. ....12. *B. pekinensis.*

HH. Radical and lower stem-leaves without prominently winged petiole.

I. Stem-leaves clasping.

J. Shape of stem-leaves short and very broad, almost orbicular: biennial..... 13. *B. narinosa* n.sp

JJ. Shape of stem-leaves long and narrow, mostly with expanded base: biennial or annual..... 14. *B. chinensis.*

II. Stem-leaves not clasping.

J. Shape of stem-leaves long and narrow, petiolate or with a narrow base: mostly annual ....15. *B. parachinensis,* n.sp.

JJ. Shape short, elliptic-ovate to ovate or even broader, with petiolate base: biennial or annual.....16. *B. dubiosa,* n.sp.

DD. Mature silique erect and closely appressed to rachis of raceme: annual .....17. *B. nigra.*

BB. Beak of mature silique long and flat or 2-edged, usually or often containing a seed in the indehiscent cell.

C. Silique mostly glabrous: beak 2-edged, much shorter than body: annual....18. *B. arvensis.*

CC. Silique hairy: beak flat, equalling or exceeding body: annual....19. *B. alba*

1. **Brassica oleracea,** L. Sp. Pl. 667.
B. oleracea var. *sylvestris,* L. l.c.
B. sylvestris, Mill. Gard. Dict. ed. 8. (1768).
B. oleracea var. *fruticosa sylvestris,* Metz. Syst. Kult. Kohlart. 12 (1833).

Stout glaucous glabrous perennial (also biennial?): stem 3 dm.–1m. and more tall, frequently branching, decumbent or sometimes erect, often prostrate with the weight of fruit, becoming rough and scarred: root hard and strong, fusiform or branched: radical and lower stem-leaves thick and heavy, somewhat fleshy, 1.5–5 dm. long, ob-ovate or oblong in outline, petioled, usually strongly lobed at the base and often with small lobes on the petiole, margins variously angled, shallow-lobed, sinuate or irregularly dentate, mostly undulate, with many strong ribs or veins arising from the midrib; upper stem-leaves long-oblong to linear-oblong, obtuse, sinuate-dentate, sessile, dilated at the base, some of them somewhat clasping: inflorescence composed of racemes, 12–30 cm. and more long, the flowers remaining in anthesis along the axis beneath the terminal cluster of buds, the flowers on pedicels 1.5–2 cm. long: flowers large, 1.5–2.5 cm. long, erect or ascending on their pedicels, whitish yellow, cream-colored or ochroleucous; calyx narrow and erect, the sepals more or less appressed to the corolla and somewhat saccate at base; petals long-tapering; limb expanding, round-oblong: fruit 6–11 cm. long, 4–5 mm. thick, with tapering slender-pointed beak 1–2 cm. long which has the enlarged stigma intact, pedicels about 2 cm. long and mostly recurved; valve with strong keeling central rib and lighter anastomosing lateral veins: seed globose, usually obscurely angled, 1.5–2.5 mm. diam., brown-black, minutely alveolate—Coasts in W. and S. Europe.

This species yields a marvellous progeny. Numbers of kinds are described and illustrated in the pre-Linnæan works. Linnæus gathers these up into several varieties, taking over the categories of the Bauhins and naming them. Part of his varietal names can be utilized, but others represent foliage-classes distinguished by color or laciniation and cannot be consistently pressed into service now. Latin varietal names should designate botanical divisions, or at least good domesticated and cultural groups. I have not been able to satisfy myself whether the forms intended in the Linnæan varieties *selenisia* and *sabellica* are now cultivated by us, and I have therefore not used the names.

The ameliorated forms of *B. oleracea* fall into four classes or groups: (1) the kales or borecoles, in which the separate leaves are used for food or for stock feed; (2) brussels sprouts, in which developed axillary buds provide the edible product; (3) heading cabbages, developed into a great terminal bud or head; (4) the cauliflowers and broccolis, with thickened and modified edible flower-clusters.

Of these four classes, the kales are the most heterogeneous. It is customary to assemble all the kales under var. *acephala,* although it is doubtful whether the genetic re-

lationships sustain such association. In this class several groups are clearly distinguished. I had once decided to name these groups as regular botanical varieties, discarding the name Var. *acephala* entirely for clarity; the name *acephala* is little more than an antithesis or contrast to *capitata* or the cephalous kinds. I have not cared to make too great innovation, however, and for descriptive purposes have assembled them loosely as var. *acephala* and have then made subdivisions thereunder; these divisions could very properly be given regular subvarietal Latin names, but I do not wish to introduce quadrinomials, specially not new ones.

FIG. 24. KALES.—*Brassica oleracea* var. *acephala*, ABOVE, KITCHEN KALE; BELOW, ONE FORM OF COLLARD.

Brassica oleracea var. **acephala**, DC. Syst. Nat. ii, 583 (1821); Prodr. i, 213 (1824). *Brassica acephala*, Lév. Monde Pl. xii, 24 (1910).

KALE. BORECOLE. A miscellaneous class, agreeing in producing no solid heads or enlarged axillary buds or condensed head-like thickened flower-clusters; grown for the foliage, the leaves (which are often separately plucked as the plant grows) being used as a cooked vegetable or fed to cattle: inflorescence and flowers as in *B. oleracea*; flowers sometimes very large, as much as 3 cm. long and in spread of petals, and fruit sometimes 12 cm. long, specially in the tree kales. Some varieties have much-cut and curled

leaves, often red or purplish; these are highly ornamental. To describe the kales now well known in western Europe and North America, we may recognize about six groups.

KITCHEN KALES. (*Brassica oleracea* var. *acephala* subvar. *vulgaris*, DC. l.c.). Fig. 24. Plant mostly under 1 m. tall, blooming the second year: stem scarcely woody, simple or sparingly branched: leaves more or less aggregated at top of stem, oblong to oval to orbicular in outline, lobed toward the base.—This group includes all the usual vegetable-garden kales grown in the United States. The entire plant, which is small and low, is cut; the shipment is made in barrels and crates. There are cut-leaved, crisped, green- and purple-leaved varieties. Var. *viridis*, L. (Sp. Pl. 667) apparently represents one of these forms of kale, inventoried from the "Brassica alba vel viridis" of C. Bauhin; it may equally designate green-leaved races of any of the groups of kale,—"Brassica non capitata," as Caspar Bauhin has it. Var. *laciniata*, L., is probably another form, represented by the "Brassica laciniata rubra" of J. Bauhin. A number of the crisped and cut-leaved forms, and also the color-races, have received Latin names.

PORTUGUESE KALE. Fig. 25. Biennial or plur-annual: plant low with a simple stout stock and cabbage-like aspect but making no head although sometimes

FIG. 25. PORTUGUESE KALE, BERMUDA.—*Brassica oleracea* var. *acephala*.

producing a loose tuft or rosette in the center, very glaucous: main leaves large and cabbage-like, with prominently developed whitish rib and veins, margin often finely serrate, basal lobes about 2 and small. Much grown in Bermuda, mostly by Portuguese, and shipped as entire plants to New York. This is the *Chou tronchuda* of French works, *Couve tronchuda* in the Portuguese.

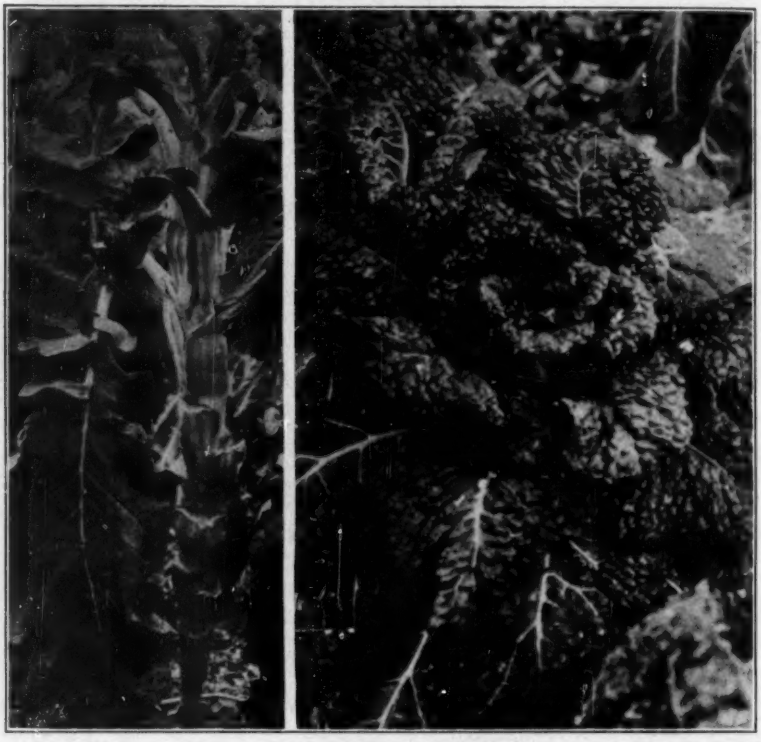

FIG. 26. MARROW KALE AT LEFT.—*Brassica oleracea* var. *acephala*. SAVOY CABBAGE AT RIGHT.—FORM OF *B. oleracea* var. *capitata*.

COLLARD. Fig. 24. Biennial or potential perennial, with a simple stout stock 1 m. high in developed old plants: leaves very glaucous, in a heavy crown but not forming a solid head, the larger ones with blades 4–5 dm. long and nearly or quite as broad, rounded or oblong in outline, margin mostly sinuate or shallowly lobed, with more or less small lobing at base: young plants may be harvested entire, but from old over-wintered plants the leaves may be taken as wanted. Much grown in the south Atlantic states; sometimes cabbage is grown for the young plants that are used and known as collards.

TREE KALE. (*B. oleracea* var. *acephala* subvar. *palmifolia*, DC. l.c. *B. oleracea* vars. *procera* and *flandrica*, Alef. Landw. Fl. 235 Var. *frutescens*, Vis. Fl. Dalmat, iii (1852), 135). Perennial, usually or often not blooming till the third year, the stem simple and mostly straight, becoming 2–4 m. tall: leaves large, heavy and glaucous, harvested for food or mostly for fodder for cattle and also for pigs, rabbits and chickens as the plant grows, or falling naturally, the rosette therefore at the top, in some forms lobed at the base and in others undivided, sometimes fringed or curled.—This

class of plants is grown mostly in countries of dense population where land is closely utilized and cattle feed must be grown on small areas. The Jersey Cow Cabbage and the Palm kales are of this group. Walking-sticks are often made of the dry woody trunks. The young sprouts in spring make a good vegetable.

MARROW KALE. Fig. 26. Much like the Tree kales, but the stem begins to enlarge (but does not become tuberous) a short distance above the ground and forms a thick trunk with a tender flesh or marrow much relished by cattle.

BUSH KALE. (*B. oleracea* var. *acephala* subvar. *ramosa*, DC. l.c. *B. oleracea* var. *ramosa*, Alef. l.c. *B. oleracea fruticosa hortensis*, Metz., Kohlart. 8, 13). Erect strong branching plants making a bushy head standing 1–2 m. high and nearly as broad, perennial or potentially so: the stem usually begins to branch at 2–5 dm. from the ground. These are cattle-feeding plants, known also as Branching and Thousand-headed kales or borecoles. I have taken this plant in the Orinoco Valley, grown in a tub by a residence, the leaves being removed for food as the plant grows. I have observed similar use of the plant elsewhere.

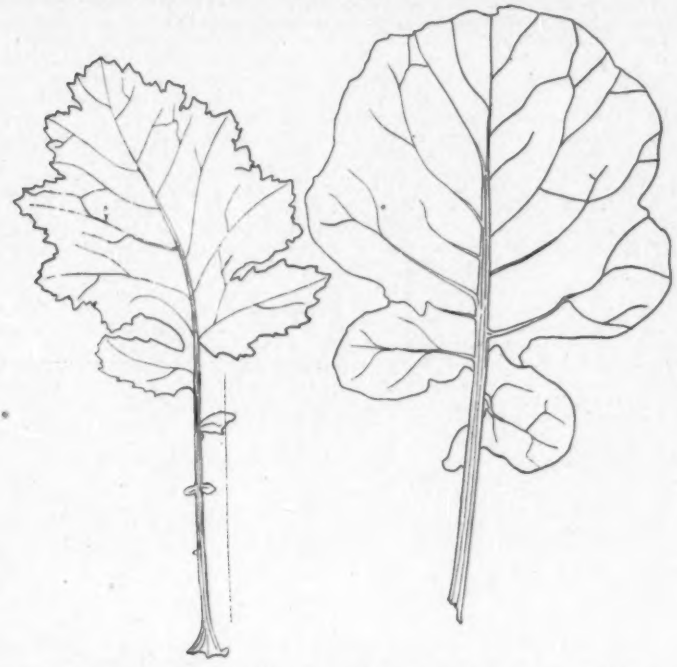

FIG. 27. LEAF OF *Brassica caulorapa* (KOHLRABI) LEFT; *B. oleracea* var. *gemmifera* (BRUSSELS SPROUTS) RIGHT.

Brassica oleracea var. **gemmifera**, Zenker, Fl. Thueringen, xv, 2 (1836?)
B. oleracea var. *bullata*, DC. subvar. *gemmifera*, DC. Syst. Nat. ii, 583 (1821).
Brassica gemmifera, Lév. Monde Pl. xii, 24 (1910).

BRUSSELS SPROUTS. Stout, simple, erect, .5–1 m., with large soft buds 2–3 cm. diam. borne in the axils of the leaves practically throughout the length of the stem: leaves short and broad, blade 12–30 cm. diam. and about as long, short-oblong to nearly circular, sometimes unlobed but commonly with one or two rounded ear-like lobes near the base, the margins entire or only repand; petiole not winged; leaves of young plants often exhibit the characteristic shape and continuous margin; leaves of

flowering stems obovate to oblong, obtuse, tapering to a petiole, margins usually obscurely shallowly toothed: flowers produced the second year. The characteristic leaf-form of brussels sprouts is seen in Fig. 27.

Brassica oleracea var. **capitata**, L. Sp. Pl. 667.

Brassica capitata, Lév. Monde Pl. xii, 24 (1910).

HEADING CABBAGE. Plant low and stout: stem simple, producing one terminal head or giant leaf-bud 10–30 cm. or more diam., which in height and breadth usually exceeds the stem or stump: leaves large (large ones reaching 40 cm. long and broad), spreading, at maturity more or less cucullate or "full," oblong-obovate to nearly circular, the larger ones mostly unlobed and tapering to a very short broad winged petiole, some of them slightly lobed at base, margins undulate and variously obscurely toothed; leaves of flowering stems mostly prominently toothed, tapering to short semi-clasping base or the uppermost becoming nearly linear and much narrowed below: flower-stems arising from the axils in the heads (heads usually being split to let them out) or sometimes from the stump, produced the second year.—There are many head-forms; and in the savoy cabbages, *B. oleracea* var. *sabauda*, L. (var. *bullata*, DC. *B. bullata*, Lév.) the leaves are bullate or blistered. Fig. 26. There are races with red-purple foliage, var. *rubra*, L. (*B. capitata*

FIG 28. CHARACTERISTIC LEAF-FORM OF CABBAGE (a), AND OF CAULIFLOWER (b)

rubra of Bauhin). Characteristic leaf-shape of var. *capitata* is drawn in Fig. 28, in comparison with that of cauliflower.

Brassica oleracea var. **botrytis**, L. Sp. Pl. 667.

Brassica cauliflora, Gars. Explic. Sept Cents dix-neuf pl. 123 (1765); Fig. Plant. Anim. Med. t. 179 (1764)?

B. botrytis, Mill. Gard. Dict. ed. 8 (1768).

CAULIFLOWER. BROCCOLI in part. Stout erect plant, the stature of var. *capitata* but leaves usually standing higher, bearing a single head of transformed flower-clusters: leaves long-oblong or elliptic, 15–24 cm. broad and usually twice or more as long, with long flat mostly winged base or petiole, usually undivided but sometimes obscurely and irregularly lobed below, margins entire or minutely denticulate, strongly ascending and overtopping the head or center: head composed of a condensed mass of short thick decolored peduncles and pedicels and thickened undeveloped flowers together with the attendant bracts; the little consolidated inflorescences are combined into larger globular-topped clusters, forming the "curds" of the head: flowering panicle arising the second year, usually bearing in its lower part many little clusters of undeveloped flowers, but in the upper part producing the regular functional cabbage-like whitish flowers and elongated fruits; bracts small and mostly few, entire or nearly so. Fig. 28 shows characteristic leaf-form of cauliflower.

Brassica oleracea var. **italica**, Plenck, Ic. Plant. Medic. vi, 29, t. 534 (1794).

B. oleracea var. *asparagoides*, DC. Syst. Nat. ii, 587 (1821).

ASPARAGUS OR SPROUTING BROCCOLI. Stature and foliage much as in Var. *botrytis* but not producing a solid head: grown for the thickened flower-shoots that are produced in the crown and also from the leaf-axils, making a more or less open short large panicle; these shoots may bear flowers that are not abortive and that are taken for eating before the flowers open, or they may be more or less elongated branches on which heads or knobs of abortive flowers are borne; the shoots are usually produced in the spring (plants 1 year old): fertile inflorescence open and branching as in other forms of the species, the bracts large and leafy, prominently toothed and sometimes laciniate.

2. **Brassica caulorapa**, Pasq. Cat. Ort. Bot. Napoli, 17 (1867).

B. oleracea var. *gongylodes*, L. Sp. Pl. 667.

B. oleracea var. *caulo-rapa*, DC. Syst. Nat. ii, 586 (1821).

KOHLRABI. Biennial, low and stout, erect, 3–6 dm. over all when not in bloom, glaucous and glabrous throughout: stem short, beginning to swell at 2–4 cm. above the ground and producing a solid oblong globular or depressed-globular leaf-bearing edible tuber 5–10 cm. and more in diameter and which may continue to enlarge in the upper part producing a misshapen object: leaves thin and relatively small, 20–30 or 40 cm. long of which about one-third to one-half is slender marginless petiole with an expanded base; blades oval to round-oval or oval-oblong, margins prominently irregularly dentate or notched, base of blade with one lobe on one side or one on either side; petiole usually bearing a very few little lobes or leaf-fragments; leaves of main flowering stem much like the radical ones but smaller, the petiole distinct and slender; upper leaves of flowering stems as in *B. oleracea*: fruit as in *B. oleracea*, but beak usually very short and often swollen at base: seed small, 1–1.5–2 mm. diameter, minutely alveolate, mostly strongly angled. The characteristic leaf-form of kohlrabi is shown in Fig. 27.

Known only as a cultigen and commonly cultivated. In pre-Linnæan times the plant was known as Caulo-Rapum (signifying "stem-turnip"), *Brassica caulo-Rapa* and *Brassica gongylodes*. The name *gongylodes* was elevated to specific rank by Philip Miller, 1768, but for a different plant, based on *Napus sylvestris* of Bauhin, a name cited by Linnæus in Hort. Cliff. as one support of the plant later named by him *Brassica Napus*; otherwise his use of the name *gongylodes* has no connection with its use by Linnæus in his *B. oleracea* var. *gongylodes*. Miller's plant is probably a form of rape; but as it may yet have to be reckoned with, we cannot fall back on the *Brassica gongilodes*, Vietz, Abbild. t. 354 (1817) sine descr.; there is special satisfaction in being able to retain the name *caulorapa*, which has such definite use with the old herbalists and which is associated with the origin of the name *kohlrabi*.

The leaf- and stem-characters and habit of *B. caulorapa* are so unlike those of the forms of *B. oleracea* that for descriptive purposes I am impelled to keep the plant distinct; and, moreover, I have no good evidence to support the union of the two.

†3. **Brassica alboglabra**, spec. nov. Fig. 29.*

Annua celeriter crescens, radice tenui caulem crassitie non excedente, tota glabra te

*The dagger (†) indicates new species, varieties, etc. See Gent. Herb. p. 8.

manifeste glauca, foliis firmis; plantae juniores Brassicae oleraceae similes: caulis erectus et valde ramosus ramis ascendentibus, 0.5–1 m. altus, saepe florescens 30–40 cm. altus: folia radicalia lamina ovali ad 10 cm. longa, minute irregulariter dentata, indivisa vel basi parvilobata, interdum etiam petiolo laminam aequante vel superante lobis parvis praedito; folia caulina radicalibus similia, sed saepe majora, lamina ovali vel orbiculari-ovali, margine undulata vel irregulariter et saepe argute dentata, basi pleru mque auriculata, petiolo longo basi dilatato, saepe lobis paucis distantibus praedito; folia superiora, ea ramulorum, pleraque elongato-oblonga, 8–15 cm. longa, obtusa, indivisa, margine grosse crenata, in basim caulem non amplectentem attenuata vel inferiora

FIG. 29. INFLORESCENCE AND OUTLINE LEAF OF *Brassica alboglabra*.

distincte petiolata: inflorescentia racemis multis elongatis erectis, sub anthesi floribus aliquot ab apice remotis, pedicellis sub anthesi patentibus vel adscendentibus 1–2 cm. longis: flores candidi, magni et conspicui, petalis erectis 2–2.5 cm. longi, expansis 2–2.75 cm. diam; calyx adpressus vel erecto-patens, non saccatus, sepalis lanceolatis viridibus margine hyalinis; petala venis conspicuis adscendentibus et anastomosantibus, sensim in basim gracilem unguicularem angustata, limbo oblongo integro vel leviter emarginato sub anthesi summa patente; stylus brevis, stigmate permagno: siliqua 3–9 cm. longa subito in rostrum 5–10 mm. longum contracta, valvis costa prominente et venis gracilibus anastomosantibus: semina magna, circiter 2 mm. diam, e basi leviter applanata conico-subglobosa, obscure cinereo-brunnea, minute foveolata.

Grown from seeds received from Canton, China, under the name "Yeung Kaài ts'oi," the "leaves cooked like cabbage;" also from Nanking. A distinct-looking annual plant, with its glaucous character, glabrous foliage, oval leaves which are petioled or not clasping, elongated inflorescence, and large white flowers. Seeds sown in April have given me plants in full bloom July 1, and in mature fruit July 20; sown July 3, have given me full bloom early in September.

4. **Brassica Napus**, L. Sp. Pl. 666.

B. campestris var. *Napus*, Babington, Man. Brit. Bot. ed. 8, 31 (1881).

RAPE. Annual, but autumn-sown (and self-sown) plants survive the winter and bloom the following May or June, glaucous throughout: main or tap-root hard and long, narrow fusiform, not fleshy, bearing at its top a crown or thickened stem of leaf-scars, the upper part free of side-roots but otherwise bearing side-roots and branches: stem .5–1 m. tall and sometimes more, erect, branched, glabrous, often purplish in lower part: leaves of very young plant and of unfolding crown bearing few scattered white setose hairs mostly beneath and on the margins, otherwise glabrous: radical and basal leaves 10–40 cm. or more long and half or less as broad, lyrate-prinnatifid, the lobes decreasing in size downwards to the distinct flat often narrow-margined petiole, usually 2–4 pairs, the terminal lobe very large and obtuse, margins irregularly dentate or shallowly sinuate-lobed: lower stem-leaves, those above the basal ones (often falling early), several-lobed and contracted below into a narrow part like a winged petiole; other or main stem-leaves oblong-lanceolate, sharp-dentate, obtuse or short-acute or the uppermost small ones acuminate, all expanded-clasping at base: inflorescence an elongating raceme, the flowers in anthesis more or less aggregated at the end but sometimes scattering ones far remote, not prominently overtopping the terminal flower-buds: flowers light yellow, 1.5–2 cm. across, on slender strongly ascending pedicels; sepals narrow and the calyx more or less open (sepals not appressed), not saccate; petals with slender bases or claws somewhat shorter than the sepals, the blade oblong-obovate, wide-spreading, the apex entire or slightly emarginate: fruit slender and long, 5–10 cm. long and 3–4 or 5 mm. broad, on ascending pedicels 1–3 cm. long, with a fairly strong rib and weak anastomosing side-veins, the beak prominently slender, mostly above 1 cm. long and sometimes 2 cm.: seeds globose, slightly angled, 1.5 mm. diameter, brown-black, very minutely alveolate.

The plant I have here described is the rape; as I have indicated, this is not exclusively the plant of Species Plantarum, but the *B. Napus* of Linnæus must either be dropped or re-limited. I have chosen the prevailing interpretation of the species, and also that suggested by the description in Hortus Cliffortianus and the subsequent specimen in Linnæus' herbarium. Colza (that is, cole-seed), the source of colza oil, I assume to be a race of the same species. Rape sometimes selfsows in fields where it has been grown for forage or cover-crop, but does not long persist. The oil-yielding races are little known in this country.

5. **Brassica Napobrassica**, Mill. Gard. Dict. ed. 8 (1768).

B. oleracea var. *Napobrassica*, L. Sp. Pl. 667.

B. Napus var. *Napobrassica*, Reichb. in Moessler Handb. Gewächsk. ed. 3, ii, 1220 (1833)

B. campestris var. *Napobrassica*, DC. Syst. Nat. ii, 589 (1821).

B. campestris var. *napo-brassicata*, Prain, Bull. 4, Dept. Land Records and Agric. Bengal, 46 (1898).

RUTABAGA. SWEDISH TURNIP. Biennial, bearing a large tuberous ovoid or thick fusiform solid-fleshed edible root with a long mostly purple leafy or leaf-scarred neck and side-roots arising from the lower part of the tuber; otherwise differing from *B.*

Napus chiefly in the characters of stem-leaves, pedicels, fruit and seeds: leaves of main flowering stem prevailingly like the basal ones except smaller, having a large rounded terminal lobe and one or more pairs of small lobes on the petiole, some of the uppermost leaves and those on the branches long oblong-lanceolate with expanded clasping base as in *B. Napus*: fruiting pedicels stout and strongly divaricate rather than ascending, the young fruit inwardly curving or falcate: fruit mostly shorter than in *B. Napus*, with a stout beak usually less than 1 cm. long and often only 3–5 mm.: seeds smaller, the hilum in a flattened or sunken area, side grooves usually more marked. The tuber of rutabaga with crown or "collar," is seen at the right in Fig. 30.

† **Brassica Napobrassica var. solidifolia, var. nov.**

Folia non profunde lobata, non pinnata, lamina sensim in petiolum marginatum desinente vel in parte inferiore crenata et leviter sinuato-lobata.

STRAP-LEAVED RUTABAGA. Leaves without deep lobes, not pinnate as in *B. Napobrassica* itself, the blade tapering nearly or quite continuously into the margined petiole or with only notches and shallow angle-lobes on the lower part. This is the counterpart of the Strap-leaved race of *B. Rapa* shown in Fig. 34, although not so common and well known as in that species. The most constant variety of this race I have grown is the French "Chou navet blanc hâtif à feuille entière."

Rutabaga is commonly cultivated (known only as a cultigen), being sown in late spring or early summer for winter use; sometimes the tubers, if left in the ground, throw up flowering shoots the following spring but it is doubtful whether the plant becomes spontaneous. The affinity is clearly with *B. Napus* as represented in the rape, and the distinctions are close. In some cases the seed-pods are as slender-beaked as in forms of rape. For the present, however, I prefer for descriptive purposes to keep the plant separate from *B. Napus*. Most of the horticultural varieties known to me have yellow-fleshed tubers: these are apparently referable to *B. campestris* var. *Napobrassica* subvar. *Rutabaga*, DC., whereas the white-fleshed varieties are subvar. *communis*, DC; these subvarietal names, however, may well be discontinued for present-day uses. In North America, the word rutabaga is inclusive of both races and it is so used in this paper. The term Swede or Swedish turnip is now little known with us, and the terms turnip-cabbage or turnip-rooted cabbage of the English are never used. The relationship between the yellow-fleshed and white-fleshed varieties needs further study.

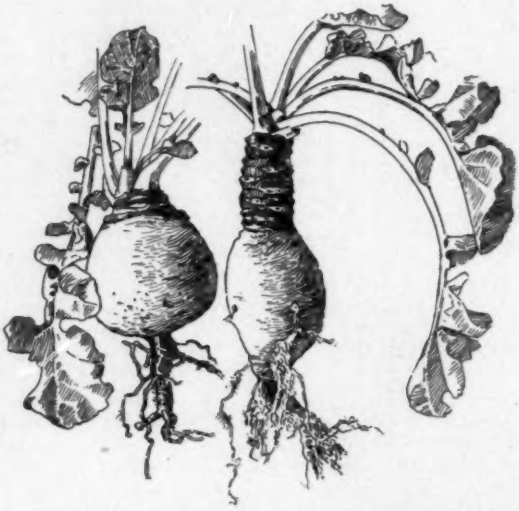

FIG. 30. CONTRAST OF TUBERS AND CROWNS—*Brassica Napobrassica* (RUTABAGA) RIGHT. *Brassica Rapa* (TURNIP) LEFT.

One hesitates to apply the name Napobrassica of Philip Miller to the Swedish turnip or rutabaga, for Miller was confused on the plant. His Latin description is that used for the turnip, "Brassica radice caulescente orbiculari carnoso," although he speaks of

it as "Turnep-rooted Cabbage" (which in modern usage, at least, is the swede or rutabaga); but he had in mind the kohlrabi, as witness his subsequent account, in the main text, of turnep-rooted cabbage, when he says that the earth should be drawn up to the stem with a hoe to preserve moisture about the root, "but it should not be drawn very high, for it is the globular part of the stalk that is eaten, so that it should not be covered."

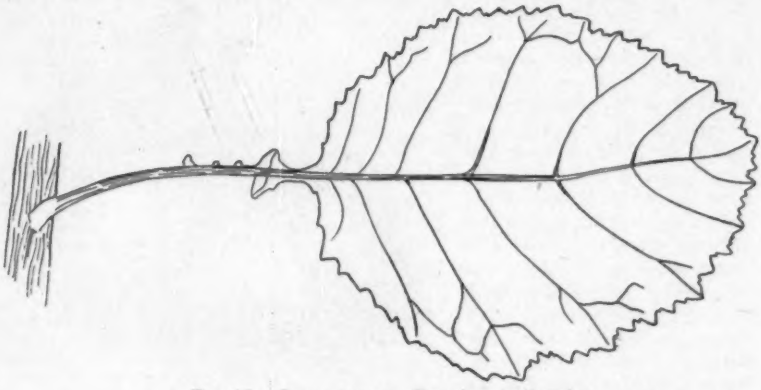

FIG. 31. STEM-LEAF OF *Brassica napiformis*.

He applies the name *gongylodes*, which is Linnæus' designation of the kohlrabi, to some form of rape or cole-seed (page 79). Yet Napobrassica seems to be tenable as a name in spite of Miller's confusion, for it has good standing in Linnaeus (as a variety of *B. oleracea*) and both men cite the "Brassica radice napiformi" of Tournefort as authority, and Tournefort cites the Napobrassica of Caspar Bauhin. Tournefort adds the name "Chou Navet" which is apparently the name for the Swede or Rutabaga class, although DeCandolle warns (Trans. London Hort. Soc. v, p. 25, 1824) that when the hyphen joins the words Chou-navet the Napobrassica or turnip-rooted cabbage is meant but that when the hyphen is omitted the true turnip is meant, and this true turnip he considers to be *B. Napus* rather than *B. Rapa*. If one prefers not to cite Miller for Napobrassica, one may fall back on the same combination in Kerner, Oekon. Pfl. iv, 7. t.312 (1791).

6. **Brassica napiformis**, Bailey, Bull. 67, Cornell Univ. Agr. Exp. Sta., 187, 189 (1894). Figs, 31, 32, the latter from Paillieux et Bois.

Sinapis juncea var. *napiformis*, Paill. et Bois, Potager d'un Curieux, ed. 2. 372 (1872)

TUBEROUS-ROOTED MUSTARD. Biennial, herbage glaucous-blue, producing a short turnip-like white tuberous root 7–10 cm. diameter: stem 1 m. and more tall, erect, branching, lightly to densely glaucous-blue: radical leaves relatively few, the blade thin and firm, 10–20 cm. long, lightly glaucous, bearing a few hairs (at least when young) on the veins beneath and on the margin, oval in outline, obtuse, usually with two rather prominent lobes at the base and several smaller ones remote on a long slender petiole, the margin sharply irregularly dentate; main stem-leaves much like the radical but broader, the blade being about 15–18 cm. long and 12–15 cm. broad, with about two small lobes at base and perhaps few much smaller ones on the petioles which are 10–15 cm. long and scarcely expanded at base; upper stem-leaves becoming oblong-lanceolate, nearly or quite entire, sessile and perhaps somewhat clasping: inflorescence in anthesis 6–10 cm. long, the central flower-buds not distinctly overtopped, pedicels ascending: flowers bright yellow, 1–1.25 cm. long, on pedicels of about their own length;

calyx loose and spreading, not saccate, the narrow sepals about the length of the claws of the spatulate petals: fruit short, 3–4.5 cm. long, abruptly contracted into a thin beak 3–8 mm. long, valves keeled, with lesser intermediate veins: seed 1–1.5 mm. diameter, angled, somewhat narrowed toward the base, brown, alveolate.

I grew this plant in 1894 from seeds obtained from Vilmorin-Andrieux et Cie, Paris, and J. M. Thorburn & Co., New York, and have never seen it since. Vilmorins informed me recently that they had not had the plant for some years. In 1921 some of my mustard plants grown from seeds received from China produced tuberous bases but they are *Brassica juncea*. The root of *B. napiformis*, as I grew it twenty-six years ago, produced a shapely conical tuber like a white turnip in appearance, texture and flavor. I assume that the seeds offered for sale at that time were from the stock sent from Peking by Dr. Bretschneider, and which appeared in French gardens in 1882. The plant was offered in the United States in 1889 (see Bailey, Annals of Horticulture, 1889, p. 121), and perhaps earlier.

FIG. 32. ROOTS OF *Brassica napiformis*.

I do not know what the *Sinapis tuberosa*, Poir. may be (in Lamarck Cyclo. Method. iv, 346. 1796). It is described as "moutarde tubereuse; vulg. rabioule. Sinapis foliis amplissimis; pedunculis siliqua longioribus, radice carnosa."

The *Brassica tuberosa*, Salisb. Prodr. Strip. Hort. Chap. All. 272(1796)is *B. Rapa*(turnip).

7. **Brassica campestris**, L. Sp. Pl. 666. Fig. 21.
B. Rapa var. *campestris*, Koch, Syn. Fl. Germ. 59 (1843).

FIELD MUSTARD. Annual, more or less glaucous throughout, with slender mostly branched not deep root (or tap-root slender if present and plant without a crown or thickened stem at surface ground): stem erect and diffusely branched or in poorly developed plants almost simple, 3 dm.–1m. and sometimes probably 2 m. tall: basal and lower leaves in strong plants 10–20 cm. long, lyrate-pinnatifid with a very large and dominant terminal lobe, the side lobes 1-several unequal irregular quasi-pairs as if on an extending petiole which is broadened and clasping at base, margins irregularly sinuate-dentate, the lower surface and sometimes also the upper provided with a few scattered white setose hairs; basal leaves on small plants often only 5 cm. or less long and little if at all lobed; stem-leaves long-oblong to short-oblong, obtuse or only short-acute, glabrous, without petiole, the base cordate-expanded and strongly clasping: flowers small, 7–10 mm. long and usually somewhat broader, bright yellow, on slender pedicels in a small cluster of which the flowers at time of anthesis and just before it commonly overtop the central flower-buds; sepals exceeding claws of petals, hyaline-margined, somewhat spreading; petal limb obovate, entire or at apex slightly emarginate, spreading: fruit on divaricate or somewhat ascending rather stout pedicels that are 5–15 mm. long and probably sometimes longer, the pod erect-spreading, 3–6 or 8 cm. long; valves with a rather prominent central vein and paralled somewhat anastomosing side veins; beak 1–2 cm. long, conical at base, slender in upper part: seed slightly more than 1 mm. diameter, dark brown, angled-globular, finely alveolate, the hilum large.

A widespread weed of fields and roadsides, introduced from Europe, and yet singularly infrequent in many parts of the country. So far as I know, it yields no cultivated forms in North America; I have detailed it here for the purpose of trying to make more clear the domesticated plants that are usually associated with it. Forms of it are ex-

tensively grown in some countries for oil-yielding seeds. *B. campestris* var. *chinoleifera*, Viehoever, Journ. Agric. Research, xx, 136 (1920), as represented in the plates, is not *B. campestris*, L.

Probably some of the spontaneous plants passing as *Brassica campestris* are really *B. Napus*: such subjects are mostly rather stout and strict, often nearly or quite simple, with a woody crown at surface of ground and a strong tap-root, stem purple below, stem-leaves elongated and prominently auricled, thick and not setose: they are likely to be over-winter plants.

8. **Brassica Rapa**, L. Sp. Pl. 666. Figs. 30, 33.
B. campestris var. *Rapa*, Babington, Man. Brit. Bot., Ed. 3, 24 (1843).

TURNIP. Biennial, producing flowers in spring from roots grown the year before: root a fleshy edible tuber, globular, oblate or sometimes oblong, with a very short crown which is not produced into a neck, the stem-base represented as an expanded disk on top, the feeding roots all rising from the tap-root beneath the tuber rather than from the tuber itself; otherwise differing from *B. campestris* in the general greenness of the plant and the strongly setose-hispid large practically compound long-stalked radical leaves: mature radical leaves green and soft, lyrate-pinnate, long and large, 30–50 cm. long more or less, of which perhaps one-third is a weak petiole bearing a greater or lesser number of small lobes or sessile decurrent leaflets, terminal lobe very large and obtuse and with undulate or shallow-lobed margin, other lobes few to several and successively smaller downward, the lower surface beset with sharp white setose hairs that prick the hand when thrust among the foliage, the upper surface usually bearing a few scattered hairs of the same kind: foliage of flowering stems sometimes green and in other plants glaucous, that on the main stem much like the radical ones and with an expanded clasping base to petiole, those higher up mostly oblong to lanceolate and undivided and sessile with a dilated clasping base, the margins toothed or the uppermost entire: flowers and fruits as described for *B. campestris*: seeds larger. The root-form is well shown in Fig. 30 in comparison with rutabaga; the characteristic leaf-form is drawn in Fig. 33.

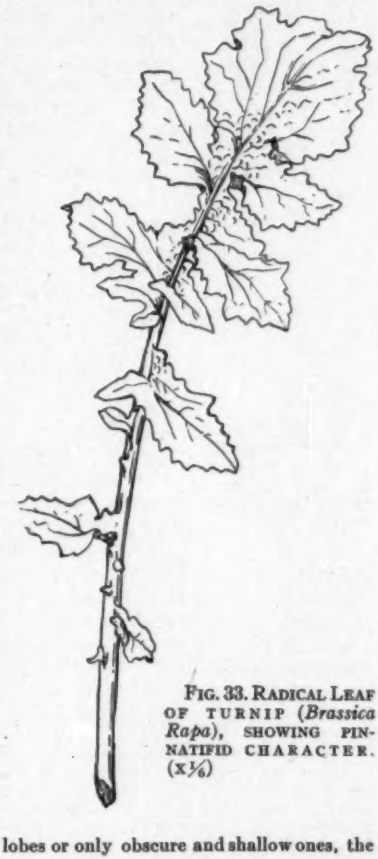

FIG. 33. RADICAL LEAF OF TURNIP (*Brassica Rapa*), SHOWING PINNATIFID CHARACTER. (x⅙)

† **Brassica Rapa** var. **lorifolia**, var. nov. Fig. 34.

Folia lorea vel anguste oblonga, pleraque eis typi speciei minora, omnino elobata vel tantum lobis levibus vel obsoletis instructa, lamina sensim in petiolum alato-marginatum attenuata.

STRAP-LEAVED TURNIP. Radical or tuber leaves strap-shaped, usually smaller than in other turnips, either wholly without lobes or only obscure and shallow ones, the blade tapering into a winged petiole. These turnips have a very distinct look in their leafage, lacking the pinnate character of the leaves of other turnips; they are well known to cultivators.

The species is commonly cultivated, maturing rapidly, sown in early spring for spring and summer use and in late summer for winter use I have not seen spontaneous plants in this country nor have I seen tubers surviving in the open and producing flowers. Usually the substance of the tubers is white, but there are yellow-fleshed kinds. I find plants with glaucous stems and leaves among those with perfectly green herbage, when they go to flower. I have not been able yet to attach botanical significance to these dissimilarities. The affinity of the turnip is clearly with *B. campestris*.

FIG. 34. RADICAL LEAF OF STRAP-LEAF TURNIP (*B. Rapa* var. *lorifolia*), SHOWING CHARACTERISTIC FORM (X⅙)

If the turnip ever self-sows or runs wild, we should expect the plant to be potentially biennial, making radical leaves in autumn from seeds discharged that year and sending up its flower-stalks the following season. This is what we find in the "Thames-side brassica" that grew along the Thames river, England, many years ago and which was the subject of careful observation by Hewett C. Watson and reported in Seemann's Journal of Botany in 1869 (Vols. vii, viii). This plant still persists and I have recently collected it along the Thames in Surrey. Watson writes, "My conviction is, on a familiarity with the plant during thirty years, that the Thames-side Brassica is simply the wild stock of the true turnip." "As we see by the Thames side the seeds germinate and become plants early in autumn. These live through the winter, and flower in the succeeding spring or summer. They have a tuft of green and rough radical leaves, which are more lyrate-pinnatifid than the leaves of the annual form [*B. campestris*]. As the flowering stem rises from this winter tuft in the following spring, the leaves produced on it are smooth and become glaucous in hue, especially upwards." The plant as I have taken it along the Thames has a hard woody taproot sometimes thicker than the stem. I follow Watson in supposing that it represents a feral form of the turnip species, but I should call it *Brassica Rapa*, with which its foliage also more closely identifies it. Watson calls it *B. campestris*, using this name inclusively but I prefer, for purposes of identification, to keep the names and the plants distinct. Whether the plant represents an aboriginal form from which the cultivated turnip is derived or a run-wild race of the turnip, I am unable to say. The fact that it has persisted through so many years raises doubt whether it is merely a run-wild turnip, and the fact that it so long remains as a biennial indicates that it is not merely an incidental form of *B. campestris*. It may be significant that Linnæus, who marks *B. Rapa* as biennial, assigns it to "habitat in arvis Angliae, Belgii:" did he know such a feral or spontaneous plant? I have seen nothing like this Thames-side plant in North America but I have taken it, with woody root, on the island of Barbados; if the cultivated turnip runs wild and persists, we should expect its deliverance to occur in this country as well as elsewhere: material is needed.

† 9. **Brassica nipposinica**, spec. nov. Figs. 35, 36.

Annua vel possibiliter biennis, tota glabra, viridis vel leviter tantum glauca, foliis tenuibus: radix robusta, valida, interdum cauli crassior, saepe lignosa et incrassata, apice in collum breve producta: caulis erectus, 0.40–1 m. altus, saepe ramis multis adscendentibus, interdum infra purpurascens: folia radicalia numerosa, conferta, persistentia, gracilia, indivisa, margine integra vel obscure tantum sinuata, lamina longa angusta, 8–30 cm. longa et 1–5 cm. lata, lanceolata vel oblanceolata, obtusa, in petiolum longum gracilem sensim attenuata, lamina interdum fere nulla et folio ad petiolum reducto; folia caulina inferiora longissime petiolata ut radicalia, lamina oblonga interdum sparse et obsolete crenata; folia caulina cetera elongato-oblonga vel

anguste oblongo-lanceolata vel lingulata, 6–15 cm. longa, obtusa, integra, basi dilatata et amplexicaulia: inflorescentia paucis vel multis racemis erectis, floribus graciliter pedicellatis sub anthesi in apice congestis et alabastra centralia superantibus; flores pallide flavi, parvi, 4–6 mm. longi, pedicellis gracillimis multo breviores; calyx non saccatus, manifeste viridis, sepalis lineari-lanceolatis unguiculum petalorum superantibus; petalorum limbus patens, flabellato-venosus, integer: siliquae numerosae, graciles, 4–8 cm. longae et 3–4 mm. latae, valvis costa conspicua et venis lateralibus tenuioribus anastomosantibus, rostro gracillimo 1–1.5 cm. longo: semina brunnea vel intense brunnea, subglobosa, 1–1.5 mm. diam., hilo non applanato, pleraque non foveolata.

FIG. 35. RADICAL LEAVES OF *Brassica nipposinica* AS SEEN ON HERBARIUM SHEET.

† **Brassica nipposinica** var. **laciniifolia**, var. nov. Fig. 37.
Folia lacerata, incisa et in lobos acutos divisa.

The species I here describe as *Brassica nipposinica* is a strap-leaved plant, often with long woody root and apparently biennial although maturing the first year, the foliage used for greens and pickles. I have grown it under the names *Brassica japonica*, *B. chinensis*, *Sinapis chinensis*, Kyona, Mibuna, Mizuna, and others. The undivided entire long and narrow leaves, the radical and lower cauline ones long-petioled, the

FIG. 36. SHEET OF *Brassica nipposinica*.

FIG. 37. HERBARIUM SHEET OF *Brassica nipposinica* VAR. *laciniifolia*.

upper ones auriculate-clasping, mark the species. There are certain evidences of monstrosity in the foliage. Sometimes the leaves are reduced to petiole-like shreds. In some cases, other plants have come out of the seedpackets. I see no difference in the var. *laciniifolia* except that the leaves are cut and slashed. It is apparently the *Brassica japonica*, Makino, Somoku-Dzusetsu, iii, t. 33 (1912), but I am not able

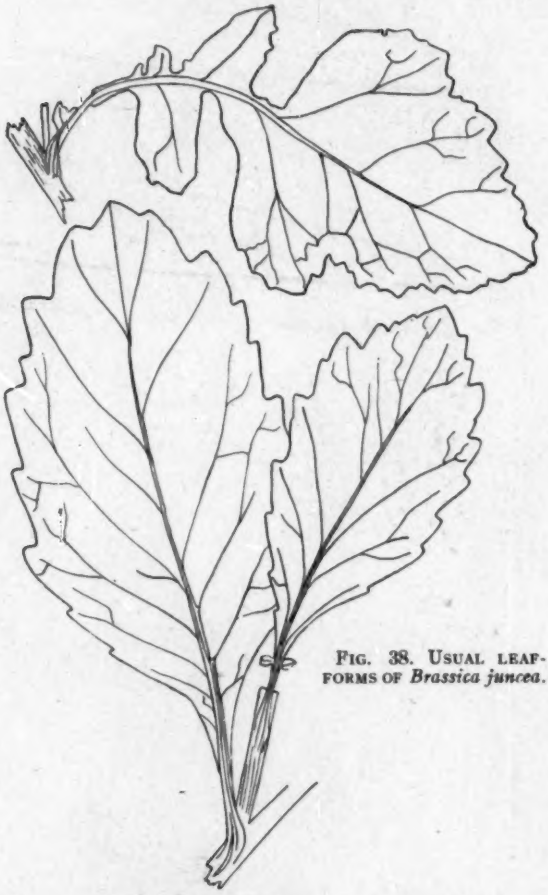

FIG. 38. USUAL LEAF-FORMS OF *Brassica juncea*.

to place the various striking drawings in this work with satisfaction, lacking details of fruits and other characters. It is not to be confused with the *Sinapis japonica* of Thunberg.

The slender long-beaked upright pods borne in profusion on divaricate pedicels are a feature of the species. I have grown one or two plants in which the pods are shorter and less slender-beaked than in the description.

10. **Brassica juncea,** Coss. Bull. Soc. Bot. France, vi, 609 (1859).
Sinapis juncea, L. Sp. Pl. 668.
Sinapis ramosa, Roxb. Fl. Ind. iii, 119 (1832).
Brassica lanceolata, Large, F . Danica, fasc. 45,7, t. 2658(1861).
Brassica cernua, Forbes & Hemsl. Journ. Linn. Soc. xxiii, 47 (1886) ? not *Sinapis cernua,* Thunb. Fl. Jap. 261 (1784).
Brassica Besseriana, Andrz.; Trautv. Bull. Soc. Nat. Mosc. xxxiii, 1, 134 (1860).

INDIAN MUSTARD. LEAF-MUSTARD of gardens. Variable annual, glabrous except sometimes setose-hispid on young leaves and stems, green or thinly, glaucous: tap-root thin and hard, or sometimes the crown tuberous-thickened: stem erect, with many ascending branches, usually lightly glaucous, 30 cm.-1.25 m. tall: leaves various, but characterized by notched rather than regularly dentate or serrate margins, soft and loose; radical leaves of the cultivated plant large, usually not long persisting, blade oval to broad-oblong to obovate in outline, 15–35 cm. long and one-third to one-half as broad, obtuse, undivided or more often lyrate-lobed or -divided particularly toward the base, the lowest lobes often small and separate on the narrow petiole, the margins variously sharply or obtusely notched or scalloped, glabrous or sparsely setose-hairy specially beneath; lower stem-leaves much like the radical ones but smaller and little or not at all lyrately-lobed, usually conspicuously angled or notched but sometimes crenate-dentate, the petiole not clasping; upper stem-leaves becoming narrow-lanceolate, narrow-oblong and linear, obscurely remotely toothed to entire, contracted to a short petiole or narrow base, not clasping: inflorescence of many elongating branches or racemes, the flowers either all clustered at the apex in anthesis and more or less overtopping the central buds, or scattered-alternate along the rachis for a distance of 4–8 cm.: flowers bright yellow, often fragrant, 7–10 mm. long at full anthesis and greater in breadth; calyx not saccate, sepals whitish or yellowish, very narrow, spreading, exceeding the claws in the corolla; petals with spreading oval to obovate veiny entire limb: fruit 4–7 cm. long, erect or ascending on stout pedicels, valves with strong midvein and lighter interlocking or looping side-veins, beak from very short and stout (3–4 mm. long) to rather slender and 1 cm. long: seeds about 1 mm. diameter, globular to globular-oblong, mostly very dark brown, hilum prominent on a rounded base, strongly alveolate. Fig. 38 shows prevailing leaf-forms of *B. juncea.*

One of the most widespread of the mustards, both as a weed and as a plante ultivated for greens, salad, pickles and for oil; native probably in Asia. I have taken it both as a cultivated and spontaneous plant in China, as a cultivated plant in Japan, as well as in the United States, Bermuda, and tropical America, and have grown it from several Chinese, Japanese and Indian sources, Both in the wild and in cultivation it is a profuse seeder, marked by the many upstanding pods and notched leaves. In cultivation it appears in many forms, sometimes with leaves nearly entire, at other times with foliage much divided or cut.

†**Brassica juncea var. crispifolia** var. nov. Fig. 39.
Folia radicalia et caulina inferiora valde lobata et incisa et propter segmenta laciniata, margine sese tegentia crispata; folia caulina superiora dentata tantum vel leviter lobata, vel summa integra.

CURLED MUSTARD. This plant (*B. juncea* var. *crispifolia*) is grown for greens and probably somewhat for decoration, the large crisped curled and fringed leaves being tender and ornamental. It has commonly been called *Brassica japonica,* but a photograph of the type specimen and a re-study of Thunberg's description indicate that another plant was then in mind. The two (vars. *japonica* and *crispifolia*) are indeed very similar, but they probably have different origins. Thunberg did not describe a crisped or curled mustard, and this character could hardly have escaped him had his plant been of that kind; the upper stem-leaves on his specimen are deeply narrowly lobed, whereas in the race I describe as *crispifolia* these leaves are usually only toothed, notched, or sometimes even entire. The dissection of the upper leaves of var. *japonica* is well shown in Fig. 40, made from a plant I took in cultivation in China, the only collection of it I have made except as I have grown it from French seeds. The division and fringing of the leaves in var. *crispifolia* are variable, and grotesque leaf-forms sometimes appear. I have taken it in cultivation in China, and have grown it under the names Ostrich Plume, Giant Southern Curled, and Fordhook Fancy Mustards. It is more or less escaped in the United States.

FIG. 39. PART OF HERBARIUM SHEET OF *Brassica juncea* VAR. *crispifolia*.

† **Brassica juncea, var. japonica, n. st.*** Fig. 40.
Sinapis japonica, Thunb. Fl. Jap. 262 (1784).
Brassica japonica, Sieb. apud Miq. in Ann. Mus. Bot. Lugd.-Bat. ii,74 (1865-6); Prol. Fl. Jap. 74 (1865–6).
Brassica nigra var. *japonica*, O. E. Schulz, in Engler, Pflanzenr. iv, 105, p. 79(1919).
Basal leaves cut-pinnatifid: stem-leaves once- or twice-pinnatifid into narrow lobes.

† **Brassica juncea var. multisecta, var. nov.** Fig. 41.
Folia omnia miltifida, in lobos vel lacinias lineares vel etiam filiformes dissecta.
Leaves all multifid into many linear or even filiform lobes or shreds. Taken in China, from cultivated plants.

In their extreme forms the three varieties might not be readily associated with *B. juncea*, but the many intermediate gradations connect them; and the characters of flowers and fruits remain.

The only specimens I have seen from the West Indies that might suggest *B. Urbaniana*, O. E. Schulz, are the cut-leaved forms of *B. juncea*. The identification, by Schulz of *Brassica cernua* var. *Chirimenna*, Makino, Somoku-Dzusetsu, iii,t. 38 (1912) with his *B. Urbaniana* confirms me in this suggestion. Schulz founded the species, *B. Urbaniana*, on *Sinapis chinensis*, L. ("non *Brassica chinensis*, L."), ascribing it, therefore, to nativity in China and supposing it to be introduced in the Antilles. The *Sinapis chinensis* of Linnæus (which is not to be confounded with his *Brassica chinensis*) was founded apparently on a description in Arduini, Bot. Spec. t.10 (1759), as his characterization of it is practically a copy of Arduini. He ascribed it to China with a question mark, following a statement in Arduini. There is a specimen in Hb. Linn., subscribed "chinensis" in Linnæus' hand, that closely matches the plate in Arduini; and Linnæus has marked on the sheet "Ard," meaning, of course, Arduini of Padua, and probably indicating that the plant was received from that source. (Another sheet in Hb. Linn., not intended in his diagnosis, is quite a diffent plant). In Symbolae Antillanae, iii, p. 512, the plate in Arduini is cited by Schulz as agreeing with the West Indian specimens of *B. Urbaniana*. Later, however, Schulz cites this plate under *Brassica Tournefortii* (in Engler, Pflanzenr. iv,105, 67). The plant under discussion, from history and synonymy, is native in the Mediterranean region and is as follows:

FIG. 40. UPPER STEM LEAF OF *Brassica juncea* var. *japonica*.

Brassica Tournefortii, Gouan, Illustr. Obs. Bot. 44, t.xxa (1773).
Sinapis chinensis, L. Mant. i, 95 (1767).
Sinapis sinensis, Geml. Syst. Nat. ed. 13, ii, 2, p. 989 (1791).
Sinapis tenella, Moench, Meth. 253 (1794).
Brassica Urbaniana, O. E. Schulz, in Urban, Symb. Ant. iii, 511 (1902–3).

In *Brassica juncea* as here defined, with special reference to the cultivated forms, I include the plant known as Broad-leaved Chinese mustard. This large-leaved form has been referred to *B. rugosa*,‡ but a photograph of Roxburgh's unpublished drawing of *Sinapis rugosa* (the drawing is at Kew), shows a plant quite unlike the cultivated forms I know. I therefore take this form away from the name *B. rugosa* and put it back under the name *B. juncea* where I first had it (Cornell Bull. 67. 1894);and yet I suspect that *B. rugosa* may be only one of the races of *B. juncea*: Prain makes it a subspecies of *B. juncea*.

Whether there is more than one species in the range here covered under *B. juncea* is a question for further study; but in a rather long line of good specimens I have been unable to find a stopping-place between one extreme and the other. Moreover, the

*n. st.: *status novus;* for explanation, see p. 8 (Gent. Herb. fasc. i)
‡*Brassica rugosa*, Bailey, Bull. 67, Cornell Agr. Exp. Sta. 191 (1894); Prain, Bull. 4, Dept. Land Rec. and Agr., Bengal. 11 (1898). *Sinapis rugosa*, Roxb. Fl. Ind. iii, 122 (1832).

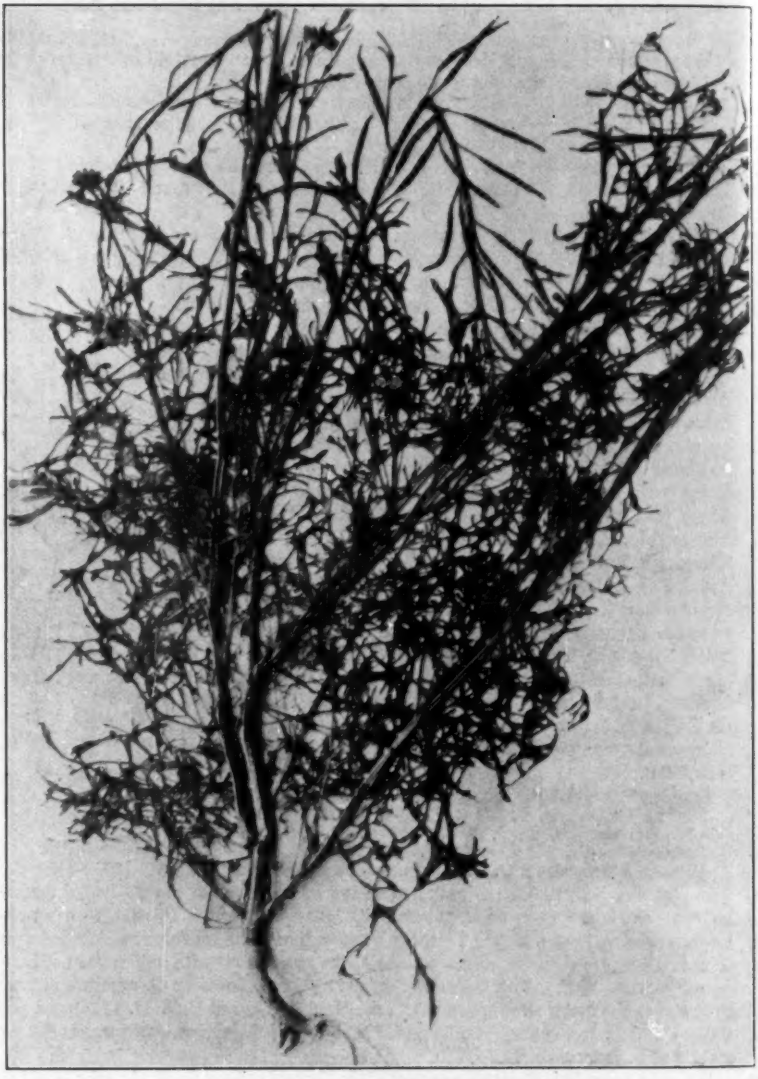

FIG. 41. HERBARIUM SPECIMEN OF *Brassica juncea* var. *multisecta*.

species is not inharmonious as it stands. It would not be difficult, however, to assemble forms with fair specific rank.

The differences between the wild weed-plant and the cultivated forms are largely those associated with size. Even in one generation of plants grown in the garden from seeds of small wild *B. juncea*, I have had a marked departure in size and dentation of leaves. In some of the cultivated strains I have had plants producing a thickened or almost tuberous base that stands well out of the ground.

Linnæus founded *B. juncea* on specimens grown at Upsala, "habitat in China" as he says in Hortus Upsaliensis (1748). In Species Plantarum he writes "ramis fasciculatis," repeated from Hort. Ups. The type specimen is preserved in the Linnean Herbarium, the name and Species Plantarum number in Linnæus' hand. The photograph of this specimen shows what is evidently a pathological subject with slender fascicled branches, apparently suggesting the name "juncea". I have taken such specimens among my cultivated plants. A second specimen in Hb. Linn., and named in his hand but without the Species Plantarum number, is the same plant. Linnæus had not only an abnormal specimen but one with leaves approaching the forms known as *B. japonica*; it is significant that in Hort. Ups., where there is the fuller description, the lower leaves are designated "lacera." I hesitate, however, to make the *B. japonica* form the type of *B. juncea*, on the basis of these specimens, because it is doubtful whether the leaves are sufficiently laciniate properly to represent *B. japonica*, and also because one does not like to elevate a variable cultivated state into such prominence. Moreover, the changes in nomenclature and the transfer of the synonomy would be extensive and the result would have no value. In further justification of my intention to let well enough alone, I may cite the reference in Species Plantarum to the picture in Hermannus, Paradisus Batavus, of "Sinapi indicum maximum, lactucae folio." This picture, which Linnæus cites under his *Sinapis juncea*, is cited by O. E. Schulz as a portrait of *B. integrifolia*, although it looks to me at least as much like *juncea* as like *integrifolia*; but my point is that Hermannus' picture does not show a cut-leaved plant like *B. japonica*, indicating that Linnæus did not mean to confine himself to his specimen.

The identity of *Sinapis juncea* Thunb., Fl. Jap. 261 (1784), remains to be cleared. It is referred to *Brassica nigra* in IndexKewensis, and this disposition of it is quoted by Juel in Plantæ Thunbergianæ. I cannot accept this disposition either on the basis of the description (as "caulis glaber," "siliquis patulis," "pedunculi capillares, patentes"), or the character of Thunberg's type specimen, of which I have a photograph. Evidently the specimen does not represent the entire material available to Thunberg when he wrote his description of *Sinapis cernua*. The specimen looks to be pathological or abnormal, and this apparently explains the feature that gave name to the plant,—"rami florentes cernui." It is very young, but the specimen has a branched inflorescence: it is apparently Raphanus; and this may account for Thunberg's statement, "flores. . . . albi."

11. **Brassica integrifolia**, Rupr. Fl. Ingr. i, 96 (1860).
Sinapis integrifolia, Willd. Hort. Berol. 14, t. 14 (1806).
Sinapis patens, Roxb. Fl. Ind. iii, 124 (1832).

Differs from *B. juncea* in the character of the leaves and the probably smaller pods: more or less glaucous: leaves not lobed or deeply cut, oval to oblong-oval or somewhat obovate, soft and yellowish green, the margin nearly uniformly doubly serrate or serrate-dentate, tapering to short somewhat margined not-clasping petiole; upper stem-leaves lanceolate to linear-lanceolate, narrowed to base but not clasping, the smallest ones entire.

Recorded as distributed about the world in the tropics and warm countries; probably Asian. I have taken it only in Venezuela, as a spontaneous plant (Fig. 42), but it is supposed to be widespread in the West Indies, although I have looked for it in vain on many of the islands. I have not been able to identify any of my oriental spontaneous or

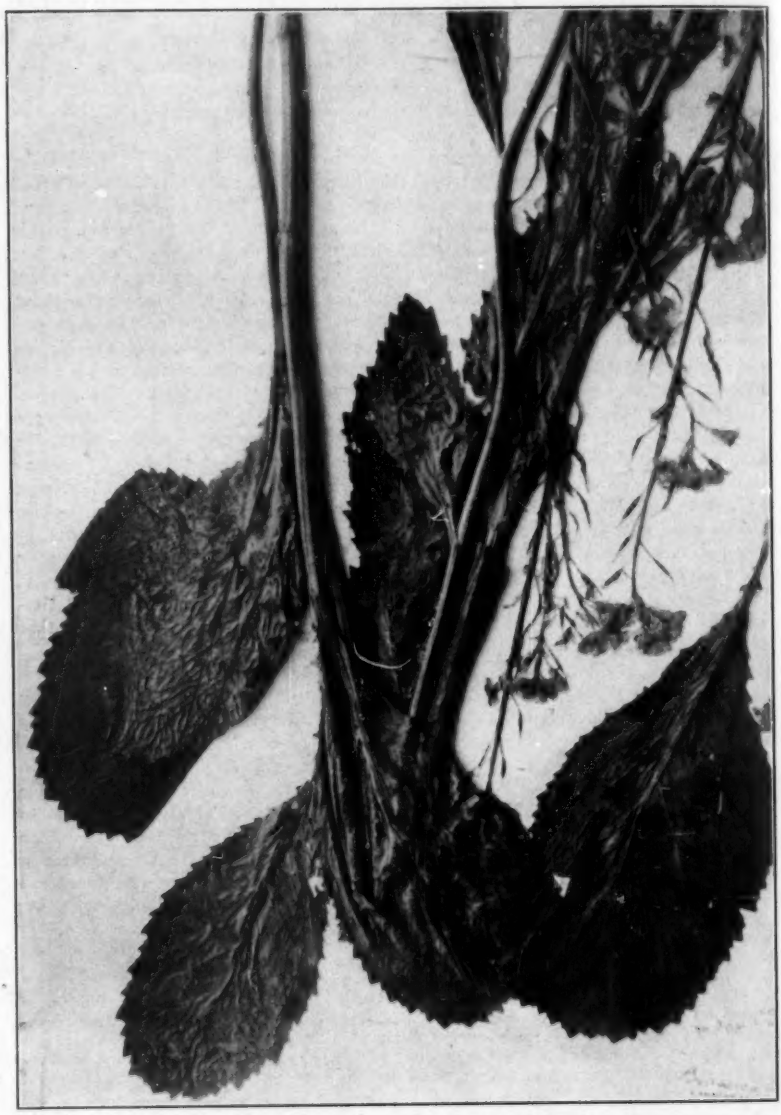

FIG. 42. SHEET OF *Brassica integrifolia*.

cultivated material with it without so extending the definition of the species as to confuse it with *B. juncea*. I suppose it is an outlying form of *B. juncea*, as it apparently does not differ in flowers, fruit or habit.

This species is best known in the excellent plate of Willdenow in Hortus Berolinensis. He gives the "habitat in India orientali." He makes no reference to the *Sinapis integrifolia* of West in the flora of the island of St. Croix* in the West Indies, to whom the species is usually ascribed. Without a type specimen of West's species (which probably does not exist) it is impossible to determine whether his plant and Willdenow's are the same. West calls his plant "wild mustard," and proceeds: "Foliis inferioribus oblongis inaequaliter serratis, supremis lineari-lanceolatis, integerrimis. *Sloane, v. i.p. 193.t.123.f.2.*" Sloane's picture, in the Natural History of Jamaica, shows only the upper part of a plant without characreristic foliage, but his description answers well for the plant figured by Willdenow.

The *Sinapis cuneifolia*, Roxburgh, is made a synonym of *B. integrifolia* by O. E. Schulz. The photograph of Roxburgh's unpublished drawing seems to support this reference. It is made *Brassica rugosa* var. *cuneifolia* by Prain in his account of the mustards of Bengal; *B. integrifolia* is not treated in that paper.

12. **Brassica pekinensis,** Rupr. Fl. Ingr. 96 (1860). Fig. 43.
Sinapis pekinensis, Lour. Fl. Cochin. 400 (1790).
Brassica Pe-Tsai, Bailey, Bull. 67 Cornell Univ. Agr. Exp. Sta., 178, 190 (1894).

PE-TSAI. Annual green soft-foliaged plant, glabrous throughout except that sometimes the leaves bear a few setose hairs on the ribs beneath: mature radical leaves numerous and large, light colored, strongly ascending and contiguous much as in Cos lettuce, without distinct petiole, 30–60 cm. long over all, obovate-oblong to broadly obovate in outline, obtuse, usually less than half as broad as long, thin, crinkled and veiny, the margins undulate and sometimes indistinctly and irregularly dentate, midrib broad and throwing off strong ascending ribs or veins, produced below into a flat whitened long base 2–8 cm. wide (like that of Swiss chard) which is margined by a wide thin notched or jagged wing; lower stem-leaves partaking of the character of the radical ones, but smaller, variously notched and crinkle-margined and narrowed into a broad flat petiole; upper stem-leaves becoming narrow, from oblong-oval to oblong-lanceolate to long-lanceolate, obtuse or only short-acute, more or less glaucous, margins entire or indefinitely toothed, either distinctly petiolate or with expanded clasping base (often both on same plant); on old and fallen flower-stems, tufts of leaves are likely to form reproducing the essential conformation of the radical leaves in miniature: inflorescence of lengthening racemes, the flowers in anthesis mostly crowded in a cluster at the apex and overtopping the central flower-buds but sometimes in more extended formation: flowers light yellow, about 8 mm. long; calyx not saccate, of rather broad nerved obtuse sepals that are loose or spreading in anthesis, exceeding the claws or erect bases of the petals; limb of petals spreading, broadly obovate, entire: fruit mostly rather short and stout, 3–5 or 6 cm. long, to 5 mm. broad, on spreading or ascending pedicels of variable length, the beak abrupt, short stout and cone-like, 4–10 mm. long, valves soft with strong midnerve and weaker interlocking side nerves: seed variable in size, usually 1–1.5 mm. diameter, globular to conical-globular, with a small base, brown or brown-gray, alveolate.

Now commonly grown in North America, under the names "celery cabbage," "Chinese cabbage" and pe-tsai, the last name to be preferred; sometimes also called "Shantung cabbage:" see Bailey, Principles of Vegetable-Gardening, 18th ed., 88, 96 (1921). There is no specimen extant, so far as I can find, of Loureiro's *Sinapis pekinensis*, but his description is sufficient to identify the plant, particularly as there is no other Brassica likely to be confused with it that has the leaf-margined chard-like petiole-base of the radical leaf. Some plants, however, shoot directly to seed and do not produce the characteristic clump or "head;" but such radical leaves as persist maintain the essential broad-winged petiole but in much less developed form. The variable foliage is the

*West, Hans. Bidrag til Beskrivelse over St. Croix, 296 (1793); Beyträge zur Beschreibung von St. Croix. German ed. 222 (1794).

FIG. 43. LIVING ROSETTE OF *Brassica pekinensis*.

outstanding puzzling feature of this plant. Although the plant runs to stalk readily, with me it has never been a free seeder.

As a cultivated plant in the vegetable garden, pe-tsai should now be carefully bred to dependable uniform named varieties. Much of the good result in the growing of the plant, however, depends on heading it in cool weather. At Ithaca, seeds sown about August 1 give good heads in late October if the ground is well-conditioned and the tillage maintained.

† 13. **Brassica narinosa,** spec. nov. Fig. 44.

Biennis crasse-foliata, interdum culta quasi annua, viridis vel luteo-viridis, tota glabra vel interdum foliis radicalibus subtus sparsissime setoso-pilosis: radix valida, interdum lignea, apice collo brevi praedita: caulis erectus, brevis et confertus, 30–40 cm. altus, sursum ramosus: folia radicalia pro rata pauca, saepe manifeste bullata vel pustulata, congesta, brevia et lata, lamina 10–20 cm. longa, orbiculari-ovata vel obovata, obtusa, margine integra vel obscure remoteque angulato-crenata, indivisa vel basi 1 vel 2 jugis loborum indistinctorum praedita, costa lata venis flabelliformibus instructa et in petiolum albidum latum et brevem 8–20 mm. latum plus minusve marginatum et interdum fragmenta foliacea gerentem desinente; folia caulina inferiora radicalibus parvis similia, lamina lata cochleata, petiolo lato brevi marginato; folia caulina cetera orbicularia vel orbiculari-ovata, amplexicaulia, integra, 4–10 cm. longa, pauca in ramis floriferis: inflorescentia racemis paucis robustis, folia tam superans, ut planta fructifera nuda sit, floribus in apice laxius dispositis et sub anthesi alabastra terminalia superantibus: flores lutei, 6–10 mm. longi, plerique pedicellis breviores; calyx non saccatus, sepalis latis obtusis flavidis unguiculos petalorum circiter aequantibus; petalorum limbus venosus, latissimus et rotundatus, integer vel leviter emarginatus, patentissimus vel reflexus: siliqua brevis, pedicellis robustis patentissimis vel sursum curvatis, plus minusve inflata, 2–4 cm. longa et interdum plusquam 1 cm. lata, valvis costa tenuiore et venis lateralibus multis anastomosantibus, rostro 4–8 mm. longo crasso conico: semina parva, 1 mm. diameter, intense brunnea, hilo conspicuo, in basim attenuata, vix foveolata.

A stout low plant producing short clusters of thick puckered leaves with broad whitened petioles, the over-wintered clusters used as a potherb by the Chinese about Shanghai, where I have taken it in the market and have grown it to fruit. I have also grown it in this country and have received it from a correspondent here. It is marked by the nearly orbicular sessile clasping stem-leaves, and particularly by the unusual thick inflated pods with very short stout beak. Fig. 45 shows the plant as sold for food in the markets of Shanghai. An unusually large-podded specimen that I took in native gardens about Shanghai, where it is much cultivated, has puffy pods 1-½ in. long and nearly ½ in. broad, of which the thick conical beak is about ¼ in. long. (Shown in the inset in Fig. 44). This species is one of the most marked of the kinds of cultivated Brassica.

14. **Brassica chinensis,** L. Cent. Pl. i, (1755), and Amoen. Acad. iv, 280 (1759), amplif.

Obscure viridis, possibiliter biennis, sed saepe anno primo fructifera, in statu florente glaucescens, tota glabra: radix firma et incrassata, saepe in tuber fusiforme enascens, plerumque apice in collum breve producta: caulis ramosus erectus, 40–70 cm. altus: folia radicalia matura numerosa, firma, viridia nitentia, patentia magis quam erecta et caput non formantia, 25–50 cm. longa et 10–25 cm. lata, obovata vel late obovata, integra vel obscure crenata vel sinuato-dentata, basi in petiolum distinctum crassum pallidum vel album non vel levissime marginatum sed interdum lobis paucis foliaceis praeditum attenuata: folia caulina inferiora radicalibus similia, sensim in petiolum marginatum basi dilatatum attenuata; superiora ramulorum florentium plus minusve glauca, obovata vel elliptica, integra, basi auriculato-amplexicaulia: inflorescentia racemis elongatis paniculatis, floribus sub anthesi approximatis vel congestis et alabastra centralia superantibus; flores pallide flavi, circiter 1 cm. longi, sub anthesi latiora (ad 1.5 cm.), pedicellum gracilem aequantes vel eo breviores; calyx non saccatus, sepalis longis angustis albidis vel flavescentibus laxis et erecto-patentibus; petala venosa, in basim longam angustam sepalis breviorem attenuata, limbo patente oblongo obtuso: siliqua magna, longa et gracilior, 3–7 cm. longa, 3–4 mm. lata, firma et non mollis, valvis costa satis prominente et venis lateralibus anastomosantibus, in rostrum

gracilius 8–12 mm. longum attenuata; semina 1–1.5 mm. diam. anguloso-globosa, basi parva, brunnea, minute foveolata. Fig. 46 shows a radical leaf.

One of the plants known as "Chinese cabbage." I grew it many years ago from Chinese sources, as Pak-choi, but have seen little of it recently. Seeds from Japanese sources yield apparently the same plant. Writing on this plant twenty-eight years ago (Bull. 67, Cornell Agr. Exp. Sta.), I spoke of it as apparently "normally biennial, although it freely runs to seed the first season if left in the seed-bed or grown on dry soils." The "leaf-stalks are light colored, sometimes almost ivory white and celery-like" and

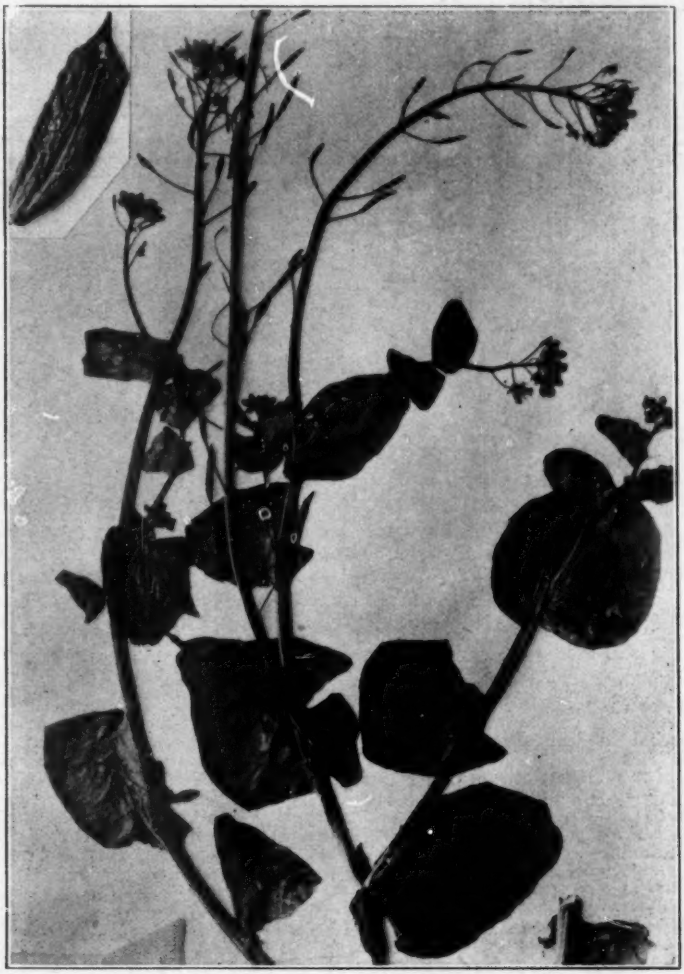

FIG. 44. SPECIMEN OF *Brassica narinosa;* INSET OF SILIQUE NEARLY NATURAL SIZE.

constitute the most edible part of the plant. "Most of the plants, if given cool moist soil tend to make a turnip-like root. These roots are not unlike turnips in flavor." At that time the plant as known in this country seemed to have small merit, and apparently it has made little headway with cultivators in North America.

In China, however, where I have seen it and have grown it to the seeding stage from

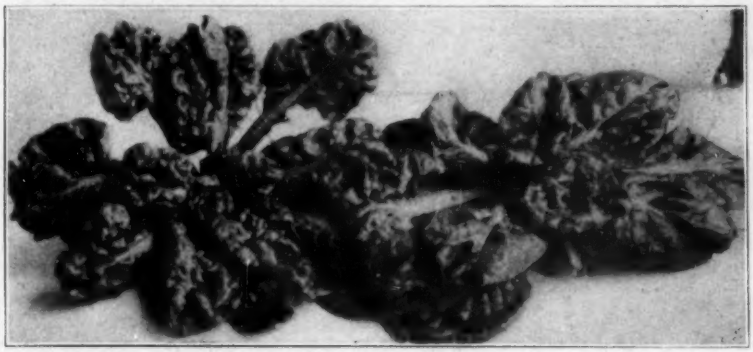

FIG. 45. TUFTS OF *Brassica narinosa* AS SOLD IN MARKETS IN CHINA.

early market wintered roots, the plant is an important article of food. In the early spring markets of Shanghai, the young shoots (more or less blanched) are tied in bunches, much after the manner of asparagus, Fig. 47. Often the flowers are opening on these shoots. It is known as "Yeu-tshia" and "Yeu-tshia-ho."

The species is distinguished by its over-winter nature, glabrous foliage, rounded undivided nearly or quite entire radical leaves tapering into a whitened petiole, and auriculate-clasping stem-leaves.

It is with some hesitation that I use the name *Brassica chinensis*, inasmuch as the original description is insufficient. Years ago (Cornell Bull. 67) I "ventured to use Linnæus' name for the Pak-Choi, although it is impossible, without an examination of his herbarium, to determine the plant he had in mind." But it transpires that there is no type specimen of *B. chinensis* in Herb. Linn., but four small specimens on one sheet placed there subsequently and named "chinensis" in Linnæus' hand. Sir J. E. Smith noticed discrepancy between the specimens and description, and has written on the sheet, "cum descriptione minime convenit." I have a photograph of the sheet: the specimens are Raphanus. The species was published under the authorship of his student Juslenius, and one wonders, in view of this sheet of specimens, how much attention Linnæus himself had given to it.

The identity of *Sinapis brassicata*, L. Syst. Nat. iii, append. 234 (1768) is to be considered in this connection. I know of no other plant than *B. chinensis* to which it can apply, but as Linnæus was so particular to keep Brassica and Sinapis distinct on calyx characters (he did not hesitate to make both a *Brassica chinensis* and *Sinapis chinensis*) one hesitates to combine the two without indisputable evidence. On the other hand, *B. chinensis* lies in the border-land between the two old genera as to calyx, and Linnæus may have meant to suggest this relationship in the name *brassicata*; moreover, as shown in the preceding paragraph, Linnæus may not have retained a clear conception of the plant described as *B. chinensis*. There is no specimen of *Sinapis brassicata* in Herb. Linn., and no reference to portrait. O. E. Schulz (in Engler, Pflanzenreich, iv. 105, p. 45)

disposes of *B. chinensis* as *B. Napus* var. *chinensis*, Schulz, a disposition probably suggested by the comparison, in Linnæus, of the plant with the *B. oleracea* group; and he makes *Sinapis brassicata* a synonym of this variety. Prain makes it a synonym of *B. chinensis*. As I cannot place *S. brassicata*, I am letting it remain a *nomen dubium*.

There is much better reason for retaining *B. chinensis*, however, and I am following Prain and others in using the name for one of the Pak-choi group; but I have amplified the description and given it a Latin rendering in order that the present application of it may have proper record.

† 15. **Brassica parachinensis,** spec. nov. Fig. 48.

Annua vel biennis, radice tenui: folia radicalia matura conferta, robustiora erecta vel adscendentia, plerumque arcte congesta, lamina quam in *B. chinensi* minore, late ovata ad fere vel distincte orbiculari, valde venosa, plerague subito in petiolum longum laevem canaliculatum viridem vel album attenuata; folia caulina inferiora radicalibus valde similia, lamina saepe orbiculari, petiolo longo non marginato et basi non dilatato-amplexicauli; folia caulina cetera ovata ad lanceolata vel anguste oblonga, omnia summis exceptis petiolata et nulla amplexicaulia; ceterum *B. chinensi* similis, sed ut videtur in statu florente planta elatior.

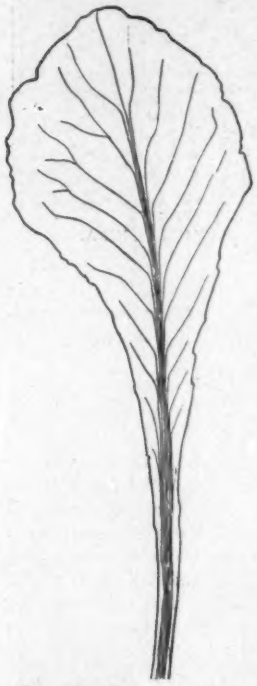

FIG. 46. RADICAL LEAF OF *Brassica chinensis.*

Annual or biennial with rounder radical leaves, not margined petioles, and for the most part distinctly stalked leaves, this plant is very different from *B. chinensis*; some of the forms are indeed puzzling, yet I have not been able to elucidate the group by throwing the things together. Considerable experience will be required to settle the status of the two species or, rather, to understand the variables; but there is here a group of plants that must be recognized. On the one extreme the variants are much like *B. chinensis* and on the other much like *B. juncea* with entire or nearly entire leaves. It is apparently a widespread type in the Orient, as I have grown it and collected it from many sources. I have also taken it in cultivation and in the market on Trinidad, British West Indies.

† 16. **Brassica dubiosa,** spec. nov. Fig. 49.

Planta biennis vel interdum anno primo maturans, satis crassifolia, viridis, glabra, foliis radicalibus fortasse subtus sparse vel conspicue setoso-pilosis exceptis; radix valida, saepe lignosa, collo brevi instructa: caulis strictus, fere simplex in speciminibus meis, ad 50 cm. altus; folia radicalia matura magna, ad 30 cm. longa, petiolo 5–10 mm. lato exalato suffulta, lamina ovali vel obovata, apice rotundata, nervis paucis prominentibus, margine integra vel leviter crenato-dentata, indivisa vel ad petiolum lobis parvis rotundatis instructa; folia caulina parva, petiolis distinctis vel longis basi dilatatis et leviter amplexicaulibus, vel superiora sessilia, lamina 3–5 cm. longa late ovali vel fere orbiculari integra interdum basi lobis minutis praedita: flores parvi, pallide lutei, 4–7 mm. longi, in racemi apice congesti et alabastra terminalia superantes; calyx non saccatus, lutescens; sepala lata, unguiculos petalorum superantia; lamina obovata vel oblonga, non lata, fere vel omnino integra: fructus tenuis, 3–5 cm. longus, erectus vel ascendens, pedicellis crassiusculis circiter 2 cm. longis suffultus; valvae costa prominente et nervis lateralibus paucis levibus; rostrum satis tenue, 1–1.5 cm. longum: semina intense brunnea, 1–1.5 mm. diam., fere globosa, basi rotundata hilo parvo notata, distincte alveolata.

I have grown this under several numbers from Nanking, China, and vicinity. Its exact relationships are difficult to make out. The long-stemmed rounded cauline leaves distinguish it. Whether we have in this group a distinct specific phylum or a range of variants from other groups are questions for further study; at present my effort is to identify an interesting but perplexing set of forms that I cannot place elsewhere. Perhaps nearest like *B. narinosa* but lacks the thick short-beaked fruits.

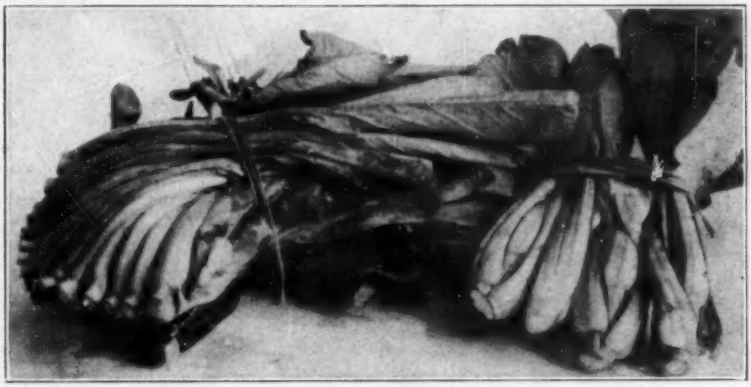

FIG. 47. BUNCHES OF *Brassica chinensis* AS SOLD IN THE MARKET, CHINA.

17. **Brassica nigra**, Koch in Roehling, Deutsch. Fl. ed. 3, iv, 713 (1833).
Sinapis nigra, L. Sp. Pl. 668.

BLACK MUSTARD. Variable large much-branching late-blooming annual, hispid-hairy or glabrous, seeding abundantly: tap-root long and hard, about the thickness of the stem, without a neck or crown: stem with long slender branches, sometimes slightly glaucous, often bearing scattered setose hairs, 1–2 or even 3 or 4 m. tall and becoming 2.5 cm. diameter at base, the bushy head sometimes 2 m. across, the bush often bearing many fine small-leaved twigs: leaves widely various in size and shape, dull green, some of them more or less hispid beneath and on the petiole, mostly angled and notched rather than dentate-serrate; radical leaves not greatly developed, not long persisting, long-petioled, pinnatifid or lobed toward the base, the terminal lobe very large, margins coarsely dentate or notched or angled; lower stem-leaves much like the radical, broad-ovate to nearly circular in outline, irregularly angle-lobed, the margins notched or remotely dentate, the bases unequal and often with one or two pairs of lobes, petiole long, not clasping, and sometimes bearing leaf fragments; upper leaves becoming narrow-ovate to oblong to linear and increasingly more entire toward top of stem, slender-petioled: inflorescence of many rapidly elongating slender twiggy naked racemes, the flowers not overtopping the terminal bud, borne in a small ovate pyramidal or rounded terminal cluster which is usually curved or declined in anthesis, flower longer than its pedicel: flowers bright yellow, small, 5–8 mm. long and greater in spread of petals; calyx not saccate, the narrow yellowish or greenish sepals somewhat exceeding claws of the petals, either suberect or widespreading; petal limb oblong or narrow-obovate, entire: fruit at first more or less spreading but soon erect and appressed to the rachis and overlapping thus forming narrow virgate racemes, 1–2 cm. long, 4-sided, valves with a prominent midvein and without noticeable side-veins, very abruptly narrowed into a slender straight beak only 1–3 mm. long: seeds 1–1.5 mm. diameter, globose to globose-oblong, hilum small, dark brown, prominently alveolate.

A common widespread weed, probably Eurasian in origin. It is the leading source of table mustard. It is also offered in varieties for greens, but apparently is little used for this purpose. Although known as "black mustard," the seeds are brown; its name is probably derived in contrast to the white mustard, *B. alba*.

There is no specimen of *Sinapis nigra* in Hb. Linn., but the identity of the plant has not been disputed, so far as I know. *S. erysimoides*, Roxb. Fl. Ind. iii, 123 (1832) is commonly referred to *B. nigra*, although Roxburgh purposely separated it from that species as is evidenced by his saying of the fruit "as in *Sinapis nigra*." The photograph of his drawing of *S. erysimoides* has the marks of *B. nigra* except that the leaves are more divided than I find to be the case in my specimens of that species; without growing the plants I do not care to state a conclusion on the species. Several varieties and forms of *B. nigra* are recorded in the literature but appear not to have been recognized in this country.

18. **Brassica arvensis**, Rabenh. Fl. Lusit. i, 184 (1839).
Sinapis arvensis, L. Sp. Pl. 668.
Brassica Sinapistrum, Boiss. Voy. Bot. Mid. Esp. ii, 39 (1839–45).
Brassica Sinapis, Vis. Fl. Dalmat. iii, 136 (1852).

CHARLOCK. Erect but mostly diffuse-spreading variable annual, hispid or glabrate: tap-root about as thick as the stem, hard and strong: stem 30 cm. to 1 m. or even more

FIG. 48. LEAF STAGE OF *Brassica parachinensis*.

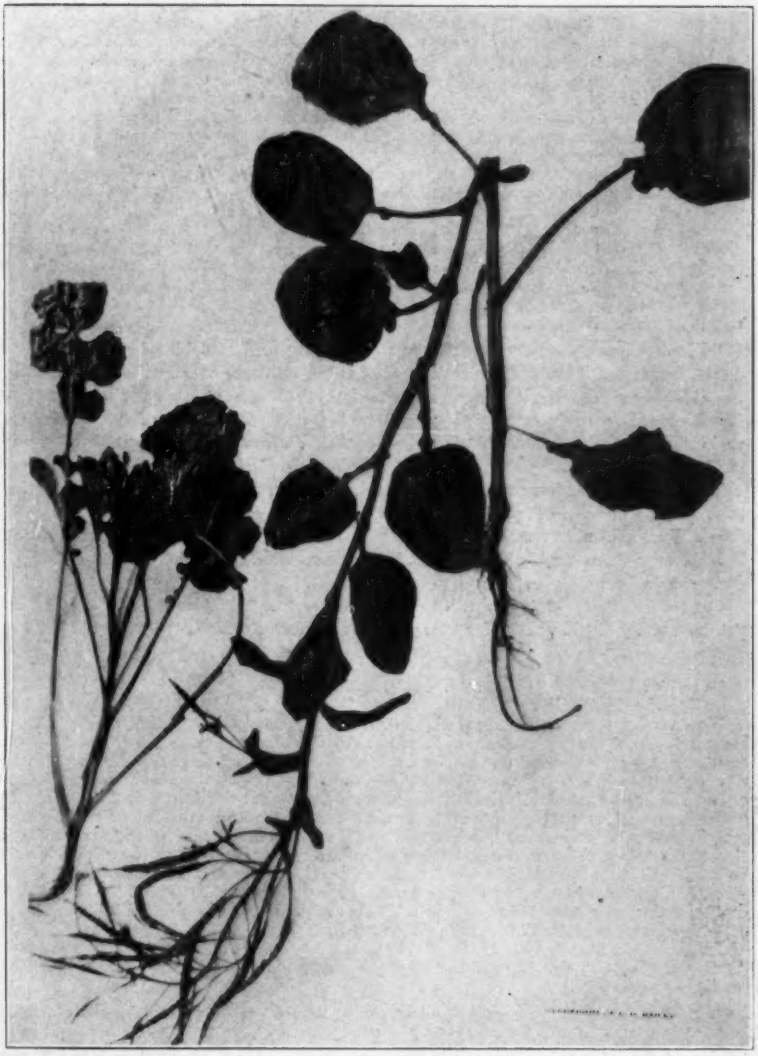

FIG. 49. HERBARIUM SPECIMEN OF *Brassica dubiosa*.

tall, usually much branched with long spreading and slender branches, sometimes slightly glaucous, often purplish below, toward the base bearing scattered setose hairs but sometimes nearly or quite glabrous, frequently hispid throughout: leaves usually not prominently lobed but the lowermost frequently imperfectly lyrate with a large terminal lobe, the main stem-leaves ovate to oblong-ovate, obtuse or short-acute, angled, notched, irregularly toothed and perhaps indistinctly shallow-lobed, more or less unequal at base, with a long petiole which often bears little lobes or fragments, mostly with setose hairs beneath; upper leaves usually becoming sessile with either a broad or narrow base and dentate, but sometimes long and narrow and entire and long-petioled: inflorescence of many long and slender racemes, the part in anthesis close and 1–3 cm. long, the flowers on pedicels shorter than themselves: flowers deep yellow, sometimes varying to whitish yellow, 5–12 mm. long; calyx not saccate, the narrow sepals equalling or exceeding the very narrow claws of the petals, widespreading and deciduous; limb of petals obovate, entire or slightly emarginate, spreading: fruit stiff, tardily dehiscing, usually ascending at maturity, sometimes the lower ones spreading, often all of them almost appressed to the rachis, on short stout pedicels, about 2–4 cm. long (or longer in some variants), glabrous but sometimes hispid, cylindrical and more or less constricted between the seeds, the valves strongly several-nerved, beak .5–1.5 cm. long, often containing a single seed, 2-edged: seed globose, 1–1.5 mm. diameter, brown or brown-black, not manifestly alveolate.

Widespread and abundant weed, the common mustard of fields of spring grain. I do not know that it is regularly cultivated or sown, although commercial table mustard was formerly made from it to some extent. During the recent War, the seed was used for mustard manufacture, being screened from spring wheat and flax and mixed variously with other mustard seed, probably with *B. juncea*. The seeds of *B. arvensis* yield no volatile oil.

This plant, *Brassica arvensis*, is variable, as befits a species so cosmopolitan. A critical study of it in this country would probably disclose several rather definite botanical races. Var. **Schkuhriana**, Fernald, Rhodora, xxiv, 36 (1922), *Sinapis Schkuhriana*, Reichb., introduced in North America, has long and slender strongly torulose siliques. Other varieties are recognized in the monographs.

Sinapis orientalis, L. Cent. Pl. i, (1755) and Amoen. Acad. iv, 280 (1759) is a form with retrorsely hispid pods (*Sinapis arvensis* var. *orientalis*, Koch & Ziz, Cat. Pl. Palat. 12. 1814).

19. **Brassica alba**, Rabenh. Fl. Lusit. i, 184 (1839).
Sinapis alba, L. Sp. Pl. 668.

WHITE MUSTARD. Stout annual, more or less sparsely hairy with deeply parted leaves: tap-root hard, about as thick as the stem, without neck or crown: stem erect, stout, leafy, 30 cm. to 1.25 m. tall, with scattered setose hairs, branching above: leaves sparsely setose-hairy or glabrous, slender-petioled, petiole not clasping, oval, ovate or sometimes obovate in outline, divided deeply or to the midrib into 1, 2 or 3 pairs of obtuse notched or angled lobes, the terminal lobe large and rounded or short-acute, margins irregularly blunt-notched, uppermost leaves much less divided: inflorescence of elongating branches or racemes, the flowers in anthesis aggregated at the apex: flowers yellow, 8–12 mm. long, about the length of the slender spreading pedicel; calyx not saccate, the narrow much spreading sepals about equalling the claws of the petals; limb of petals obovate, veiny, entire: fruit squarrose or widespreading, 2–4 cm. long, curved or straightish, seed-bearing part setose-hairy and constricted between the seeds and equalled or exceeded by the large flattened knife-like beak, valves not ribbed: seed light yellow, large, 1.5–2.25 mm. diameter, globular or globular-oblong, hilum not flattened, lightly alveolate.

Cultivated as a potherb and for the seeds; sometimes escaped from cultivation: probably Eurasian. As the species is so well understood, without dispute as to identity I have not examined the Linnæan specimen. The species has named varieties in the literature, one form with seeds nearly black and a white hilum.

V. FINDING-LIST OF LATIN NAMES

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PART II

TWO SPECIES OF HIBISCUS FROM CHINA

In reporting in 1920 on a collection of plants in China I stated (Gent. Herb. 37) that "two apparently undescribed species of Hibiscus were taken, and they have been tentatively named, described and illustrated; but further material is awaited." This material is now in hand, and the descriptions follow.

† **Hibiscus sinosyriacus,** spec. nov. Ab *Hibisco syriaco* differt foliis magnis latissimis argute dentatis et bracteis latis foliaceis calycem superantibus.

Frutex robustus erectus; ramuli juniores hirsuto-pubescentes: folia late cuneato-ovata, 3-loba, grosse et satis argute dentata, lamina 7–9 cm. longa et aeque vel fere ac lata, nervis 3 validis et utrinque laterali tenuiore instructa; petioli pubescentes, 2–4 cm. longi; flores magni, aperti, 8–9 cm. diam., lilacini; petala latissima et marginibus sese manifeste tegentia; bracteae lanceolato-oblongae, acuminatae, 2.5–3 cm. longae et circiter 0.5 cm. latae, pubescentes, calycem superantes. Fig. 50.

Kuling, a stout erect shrub, possibly planted. In general habit much like *H. syriacus*, but differing markedly in the leaves and the wide calyx-bracts.

Hibiscus syriacus, L., I took in China at Chikungshan (Hupeh-Honan), said to have been transplanted from the wild; also in temple grounds near Kioshan (Honan), supposedly planted.

† **Hibiscus paramutabilis,** spec. nov. Ab *H. mutabili* primo aspectu differt foliis basi truncatis vel fere truncatis, margine magis remote dentatis, bracteis calycinis latioribus tantum 5, pedicellis ferrugineo pubescentibus, non manifeste articulatis, floribus albis medio rubris.

Arbor parva; ramuli petiolique et folia pubescentia: folia magna, longe petiolata, lamina 10–14 cm. longa et pleraque latiore quam longa, basi truncata vel fere truncata 3-lobata, acuminata, remote repando-dentata, dentibus parvis, manifeste 5-nervia et utrinque ad marginem inferiorem nervo tenui instructa, utrinque stellato-pubescente: flores magni, 11–12 cm. diam., albi, medio rubescentes; petala obovata, obtusissima, venosa; bracteae calycis ovato-acuminatae, 2–3 cm. longae et dimidio vel ultra angustiores calycis lobos bracteis similes subaequantes vel paullo superantes; pedicelli manifeste ferrugineo-pubescentes, robusti, circiter 2 cm. longi: semina lunata, pilis longissimis deflexis instructa. Fig. 50.

Kuling, a showy broad-headed small tree, possibly planted. *H. venustus*, Blume, a tropical shrubby villous plant, probably belongs to the same group; from the present species it is distinguished by cordate strongly toothed leaves, long-pedicelled inclined or pendent flowers, and other characters. I suspect that *H. paramutabilis* is not confined to China.

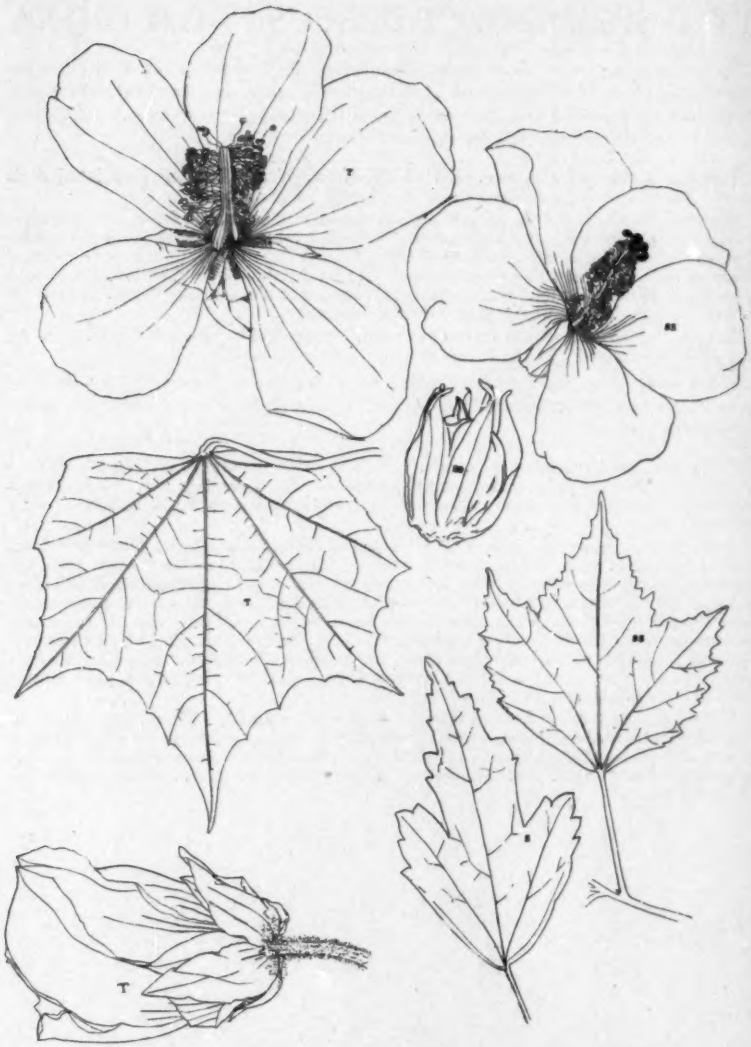

FIG. 50 HIBISCUS.—T, *Hibiscus paramutabilis*. SS, *Hibiscus sinosyriacus*. S, *H. syriacus* LEAF FOR COMPARISON